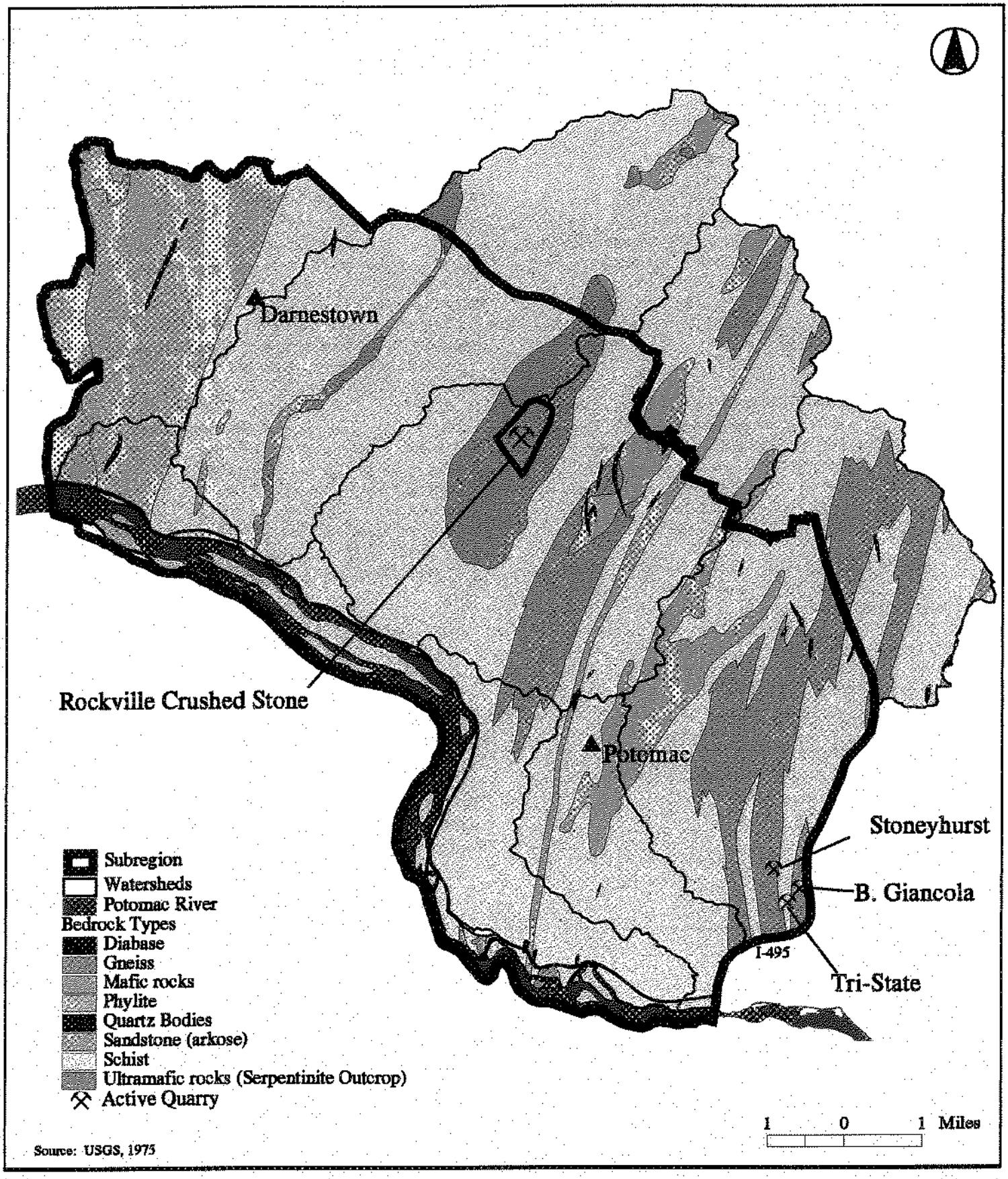
Geologic Features

Figure 3



Existing Environmental Conditions

The following description of the natural resources of the Potomac Subregion is organized in two sections. The beginning of the chapter provides an overview of the study area that examines geology and soils, vegetation and sensitive areas, habitats of rare, threatened and endangered species, air quality, noise conditions and the availability of sewer and water service. The remainder of the chapter provides a more detailed description of the natural resources and environmental conditions of the component watersheds, including portions of Seneca Creek, Muddy Branch, Watts Branch, Rock Run, and Cabin John Creek. In the Watts Branch watershed resources are described on the basis of key subwatersheds (i.e., Piney Branch, Sandy Branch, Greenbriar Branch).

Geology and Soils

The geology of the Potomac Subregion strongly influences the environmental character of the area. The underlying rock formations determine the mineral composition of the soil, help shape the topography, and affect the flow of water through the Subregion. Rock outcroppings of serpentinite and other minerals give rise to quarry operations, affect the ability to build septic systems, raise the cost of developing in certain areas, and create conditions necessary for the habitats of some rare and unusual species of plants and animals.

The Potomac Subregion lies within the Piedmont physiographic province. The bedrock of the Piedmont province in the Washington Metropolitan Area is composed of metamorphic and igneous rocks of Pre-Cambrian to early Paleozoic age. In part of western Montgomery County, these rocks are overlaid by sedimentary rocks of Triassic age and, in scattered areas, upland gravels of more recent age overlie the Triassic formations (see Figure 3). Seneca sandstone, used in early local building projects and quarried near Seneca Creek, is part of this Triassic sequence of rocks. Some of the shallow Triassic sandstones in western Montgomery County are important as local aquifers, but are not sufficiently developed east of Great Seneca Creek to be important in the Potomac Subregion.

The northeast to southwest orientation of Seneca Creek, Muddy Branch, Watts Branch, and Cabin John Creek result from subsurface faults which parallel the mountains to the west. The faults also contribute to the distinctive rock outcrops which are exposed along the Potomac River from Violettes Lock Road westward. These outcrops of serpentinite and ultramafic rock are among the most significant geologic features of the Potomac Subregion. A large serpentinite formation which lies close beneath the soil's surface in the Muddy Branch and Watts Branch watersheds is important both as a commercial mineral resource and because it results in the presence of an unusual biological community.

The Great Falls of the Potomac are evidence of another geologic feature, the fall line. This feature exists where the soft sedimentary rocks of the Coastal Plain have eroded away to expose the harder rocks of the Piedmont province.

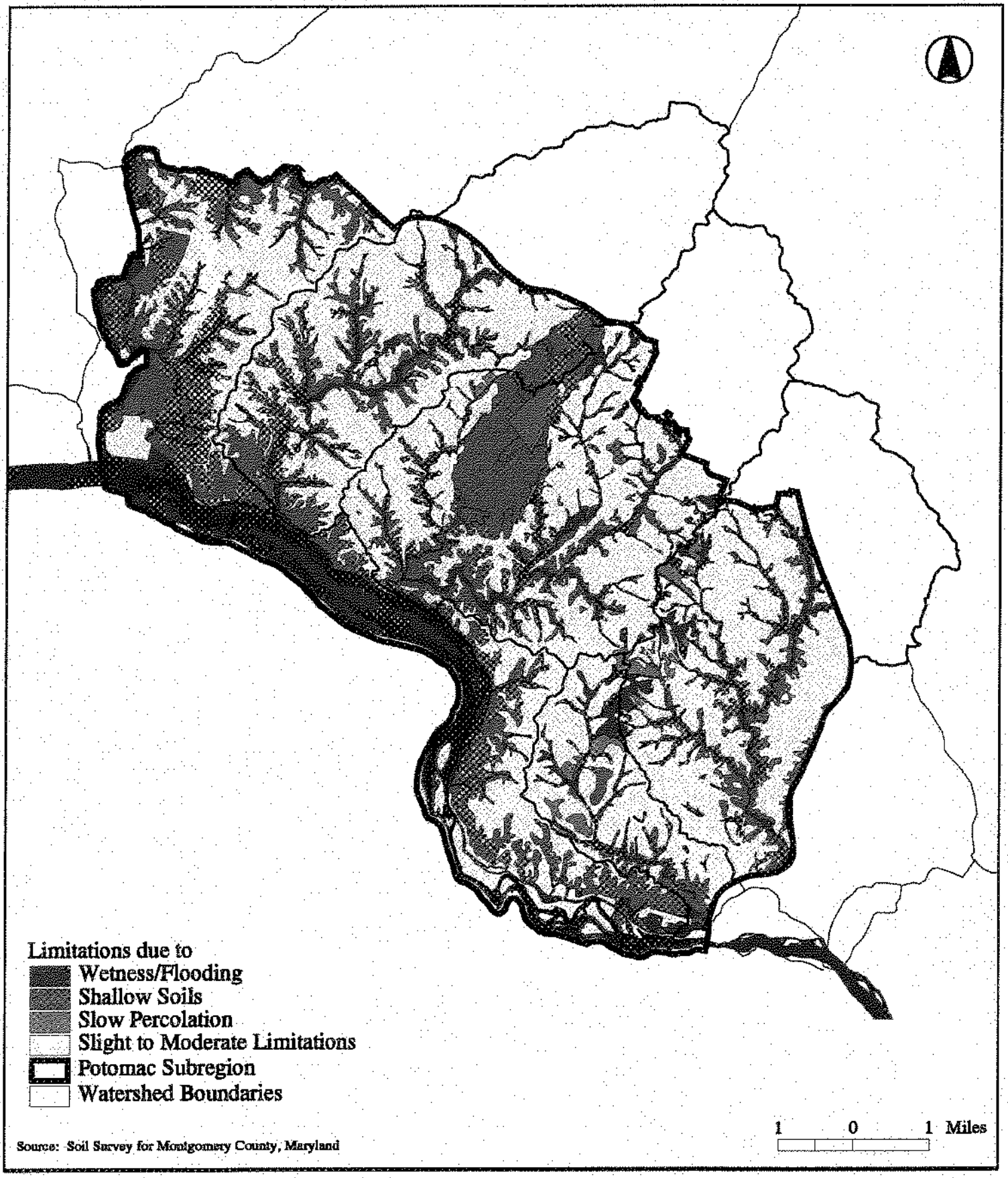
The Potomac Subregion includes large areas of thick, well-drained soils generally suitable for development. However, nearly one-third of the total area has construction limitations due to shallow bedrock, alluvium (water-deposited soils), steep slopes, and excessively or poorly drained soils (M-NCPPC 1980). Areas with construction limitations are generally found adjacent to the Potomac River, Seneca Creek, Cabin John Creek, Muddy Branch, Watts Branch, and Rock Run. The large serpentinite outcrop which is traversed by Piney Meetinghouse Road is poorly suited to development due to shallow and poorly drained soils (M-NCPPC 1980). These conditions limit the feasibility of constructing septic tanks, basements, and swimming pools and increase the cost of grading and infrastructure.

The shallow soils found in some portions of the Subregion can significantly influence the amount of water available for vegetation growth and stream recharge. Shallow soils have limited water storage capacity and may become saturated more quickly than deeper soils, reducing infiltration of water and increasing runoff. The results can be reduced water available for plant growth (especially during droughts), quicker peak flows in streams during and after storms, and reduced stream baseflows. These effects of shallow soils on both groundwater storage and baseflow conditions can be seen in the streamflow conditions in the Piney Branch and the Greenbriar Branch, both of which lie on top of shallow soils over the serpentine rock outcrop in the Watts Branch watershed.

Generally, soils west of I-270 present limitations to septic system percolation(see Figure 4). Throughout the Subregion, development using individual on-site sewage disposal systems may be constrained due to soils with a high clay content, shallow bedrock, and a high water table. This results in lower housing yields than would be expected if community sewer service were available. Especially in

Soils with Severe Limitations for Septic Systems

Figure 4



Source: Soil Survey for Montgomery County, Maryland

parts of the Sandy Branch, Greenbriar Branch, and Piney Branch basins, of the Watts Branch watershed extremely shallow bedrock limits potential for development with on-site sewage disposal systems.

Topography and Slopes

The topography of the Potomac Subregion is rolling to moderately steep. Vertical elevations within the Subregion range from approximately 70 feet above mean sea level at the mouth of the Cabin John Creek to a high of 460 feet above mean sea level in the headwaters of Muddy Branch and Watts Branch.

Slopes of the Potomac Subregion **Table 1**

Slope	Approximate Percent of Total Area
<15%	81
15 - 25%	12
> 25%	7

The majority of the Subregion has flat to moderate slopes of 0 to 15 percent (see Table 1). Steep slopes (greater than 25 percent) in the Subregion occur on the terrain facing the Potomac River and in the stream valleys. The slopes inside the Rockville Crushed Stone Quarry in the Greenbriar Branch watershed (a subwatershed of Watts Branch) are also greater than 25 percent but exist due to quarry activities and are wholly contained within the Rockville Crushed Stone Quarry property. Slopes between 15 percent and 25 percent make up a small proportion of the Subregion and generally bound the steeper slopes within the stream valleys.

Mineral Resources

Quarry products including stone and aggregate, clays, and shales are the mainstay of mineral resource extraction in the Potomac Subregion (Maryland Office of Planning, 1997) (see Table 2). These resources are actively mined at the Rockville Crushed Stone Quarry (Rockville Crushed Stone Quarry Bardon, Inc.); Stoneyhurst Quarries; Tri-State Stone and Building Supply, Inc.; and B. Giancola, Inc. Stone Quarry (see Figure 3). All these quarries are operating at a relatively low intensity as they near the end of their reserves or they reach a point of diminishing returns due to other limiting factors, as in the case of the Rockville Crushed Stone Quarry described below.

The Rockville Crushed Stone Quarry is by far the largest operating quarry. Approximately 85 percent of the rock in the quarry is serpentinite; the remaining 15 percent is composed mainly of rodingite. The quarry began operations in 1958. In 1991, the quarry was estimated to have a remaining useful life of 25 years (Boschuk et al. 1991). The three other small quarries produce building stone and flagstone. The time frame for closure of these quarries cannot be estimated. The mining will continue as long as the benefits of the operation exceed the benefits of reclaiming and developing the property.

Expansion of the Rockville Crushed Stone Quarry to mine the remainder of the serpentinite outcrop is limited.

At one time much of the mineral-bearing land surrounding the Rockville Crushed Stone Quarry was owned by the same mining company. Over time, this land has been sold and new residential communities have been

Active Mines and Quarries

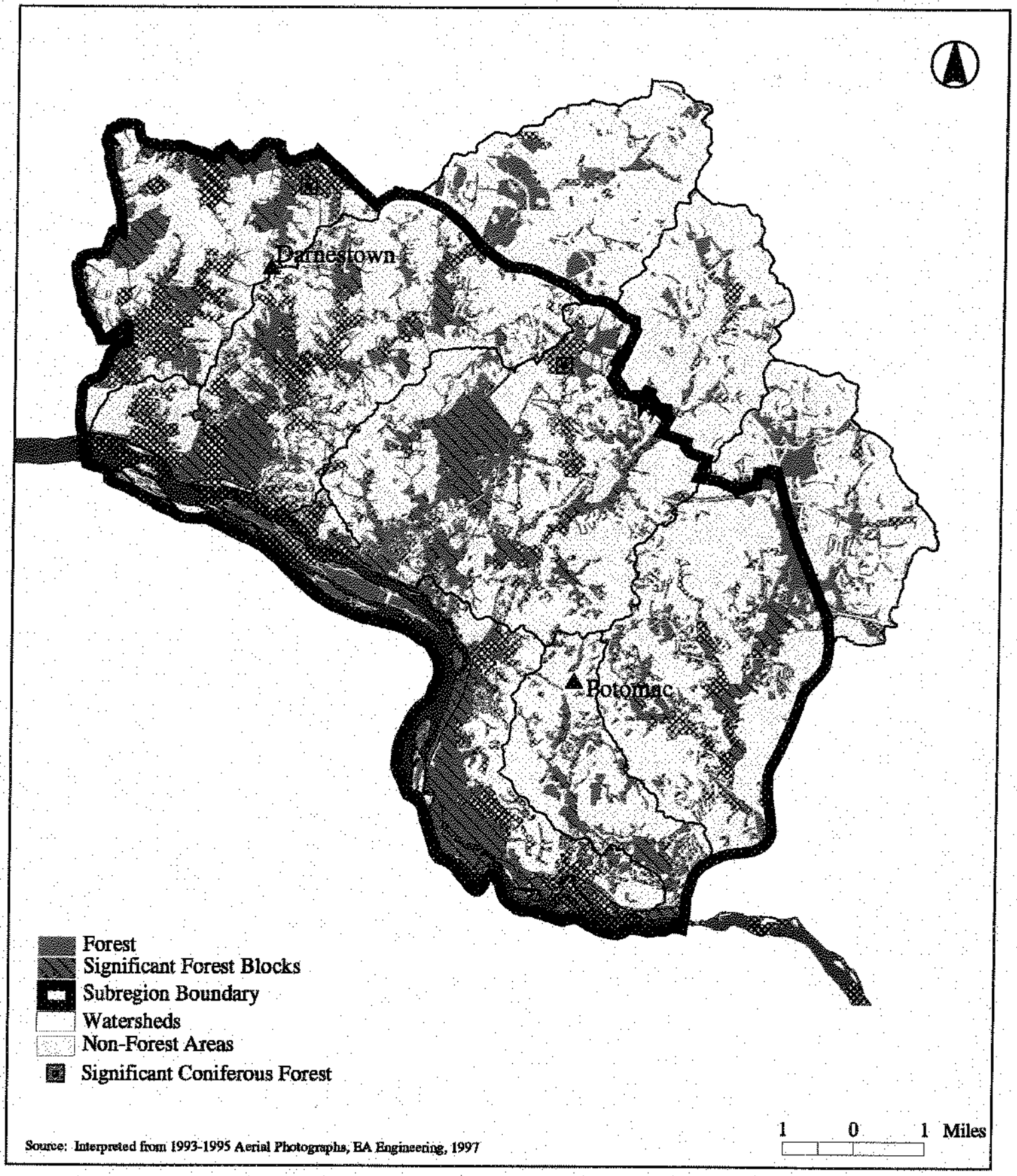
Table 2

Name of Quarry	Size[1] (acres)	Zoning	Minerals Extracted	Use of Materials	Adjacent Land Use
Rockville Crushed Stone Quarry Bardon, Inc.	302.5	I-2	Hunting Hill Crushed Stone	Road Beds Foundation	Residential
Stoneyhurst Quarries	13.3	C-1	Slate/granite	Building Stone, Flagstone	Residential/Fire Station/Road
Tri-State Stone & Building Supply, Inc.	21.5	C-1	Specialty Stone/Shale	Building Stone, Flagstone	Residential/Stream Valley Park
B. Giancola, Inc. Stone Quarry	5.5	C-1	Mica Schist	Building Stone	Residential/Major Highway

1. Size of property containing current quarry operations.

Forest Areas

Figure 5



Source: Interpreted from 1993-1995 Aerial Photographs, RA Engineering, 1997

developed such that this quarry is almost completely surrounded by residential development. The 245-acre undeveloped site south of the quarry has also been sold. This large parcel is crossed by major utility lines, and is home to rare plant and animal species, limiting the potential for future quarry use.

General Characteristics of Vegetation and Sensitive Areas

Forests

The forest areas of the Potomac Subregion provide valuable natural resource functions, including natural stream water quality and quantity management and provision of wildlife habitat and recreational opportunities. Most of the forest resources are deciduous woodlands. Pure coniferous woodland stands within the Subregion are relatively rare, and in many cases have been planted by landowners. Stands of mixed deciduous and coniferous trees[2] may occur in areas where a young forest is succeeding to a mature deciduous forest or where soil conditions favor the growth of coniferous species. Successional woodlands cover areas where forest growth is very young.

There are approximately 14,183 acres of forest in the Potomac Subregion, with 16,171 acres of forest in the larger study area (see Table 3). Approximately one-third of the Potomac Subregion is in one of the four categories mentioned above (see Figure 5 and Table 5).

The largest component of the forest is deciduous woodland, comprising 80 percent of the total woodlands in the Potomac Subregion and 78 percent of the total woodlands in the study area (EA 1997a).

The majority of the forest resources within the Potomac Subregion are associated with stream valleys and parks (see Table 4). Steep slopes and wet soils have limited logging of stream valley forests, and current development guidelines make these areas a priority for retaining or replanting trees. The forest cover within the floodplains of major streams and along the Potomac River is fragmented in places by utility, sewer line, and road crossings. Despite this fragmentation, tracts of mature woodland ("significant forest blocks") potentially large enough to support forest interior dwelling bird species are present in the stream valleys of the Subregion. Approximately 7,174 acres of significant forest blocks have been identified in the Potomac Subregion (M-NCPPC 1997b). Forest interior dwelling species require large tracts of unfragmented woodland to supply their life requisites, and therefore are vulnerable to the fragmentation of woodland areas.

Dominant tree species within the Subregion include tulip poplar (*Liriodendron tulipifera*), red oak (*Quercus rubra*), white oak (*Quercus alba*), red maple (*Acer rubrum*), sycamore (*Platanus occidentalis*), and eastern red cedar (*Juniperus virginiana*). The understory varies from location to location; however, the understory of the mature stands generally is open.

According to Brush *et al.* (1980), the tulip poplar forest association is the predominant forest type throughout most of the Potomac Subregion. This association is characterized by tulip poplar, red maple, flowering dogwood (*Cornus florida*), Virginia creeper (*Parthenocissus quinquefolia*), black gum (*Nyssa sylvatica*), white oak, sassafras (*Sassafras albidum*), black cherry (*Prunus serotina*), wild grape (*Vitis* spp.), mockernut hickory (*Carya tomentosa*), arrowwood (*Viburnum dentatum*), and Japanese honeysuckle (*Lonicera japonica*). Where this association occurs on or adjacent to well-drained bottomlands, common associates may include black locust (*Robinia pseudo-acacia*) and musclewood (*Carpinus caroliniana*); in other areas, common associates may include hickories (*Carya* spp.) and American beech (*Fagus americana*) (Brush *et al.*, 1980). Common upland associates also include various oaks (*Quercus* spp.) and occasionally mountain laurel (*Kalmia latifolia*).

Bottomlands of the upper mainstems and tributaries of Watts Branch, Rock Run, and Cabin John Creek are dominated by the sycamore-green ash-box elder-silver Maple forest association. Characteristic species of this forest association include sycamore, green ash (*Fraxinus pennsylvanica*), box elder (*Acer negundo*), silver maple (*Acer saccharinum*), flowering dogwood, wild grape, red maple, white oak, Virginia creeper, poison ivy (*Rhus radicans*), spicebush (*Lindera benzoin*), tulip poplar, black walnut (*Juglans nigra*), slippery elm (*Ulmus rubra*), and white ash (*Fraxinus americana*) (Brush *et al.*, 1980).

Bottomlands along the Potomac River and Muddy Branch as well as the lower portions of Seneca Creek, Watts Branch, Rock Run and Cabin John Creek feature the River Birch-Sycamore association. Species included in this association are river birch (*Betula nigra*), sycamore, slippery elm, green ash, spicebush, poison ivy, red maple, Virginia creeper, greenbriars (*Smilax* spp.), Japanese honeysuckle, arrowwood, tulip poplar, and black gum.

The Chestnut Oak-Post Oak-Blackjack Oak forest association occurs in the vicinity of the serpentine soil formation just south of the Rockville Crushed Stone Quarry (Brush *et al.*, 1980). Species characteristic of this forest association include chestnut oak (*Quercus prinus*), post oak

[2]This classification is composed of two subclasses: 1) mature deciduous trees with occasional coniferous trees inter-mixed with the other tree species, and 2) older successional areas where deciduous trees are overtaking and shading out the conifer component, but the conifers are still evident in the sub-canopy.

Parkland, Natural Resources, and Agriculture by Watershed[1]

Table 3

	Watershed	Parkland[2]		Sensitive Areas[3]		Forest[4]		Agriculture[5]	
	Acres	Acres	% of water-shed	Acres	% of water-shed	Acres	% of water-shed	Acres	% of water-shed
Potomac River[6]	3,394	346	10	3,178-3,394	94-100	526	15	0	0
Potomac Subregion without River	39,987	6,745	17	10,380-11,614	26-29	13,657	35	2,086	5
Lower Seneca	5,776	1,493	26	1,510-1,707	26-30	2,497	43	1,149	20
Rock Run	3,210	273	9	738-825	23-26	807	25	56	2
Direct Tributaries	5,283	1,972	37	2,138-2,195	40-42	2,796	53	245	5
Cabin John Creek	7,654	1,030	13	1,765-1,982	23-26	1,812	24	0	0
Muddy Branch	7,732	1,297	17	1,719-1,927	22-25	2,515	33	281	4
Watts Branch	10,332	680	7	2,510-2,978	24-29	3,230	31	355	3
Headwaters									
Cabin John Creek	4,138	199	5	NA[7]	NA	791	19	0	0
Muddy Branch	4,899	167	3	NA	NA	783	16	255	5
Watts Branch	3,961	271	7	NA	NA	414	10	568	14

(1) Parkland, sensitive areas, forest areas and agricultural areas overlap significantly (e.g., forest may be partially within sensitive areas). The corresponding acres and percent figures in each row should not be summed as this may result in double counting.

(2) GIS coverage of existing Parkland, M-NCPPC 1997.

(3) Range includes streams, stream buffer area (stream buffer size ranges from a minimum of 100 feet to a maximum of 150 feet for Use I streams, depending on adjacent slopes), wetlands (NWI data, DNR guidance maps, riparian areas within 15 feet of a stream, and hydric soils), wetland buffers (60 feet for Piney Branch, 100 feet for wetlands of Special State Concern and 25 feet elsewhere), 100-year floodplain (M-NCPPC and FEMA data), and steep slopes (greater than 25%) per 1997 M-NCPPC Environmental Guidelines. See Table A-1, Sensitive Resources, for more detailed information.

(4) GIS coverage of Forest interpreted from 1993-1995 aerial photography and M-NCPPC planimetrics, EA 1997.

(5) GIS coverage of Undeveloped Resources interpreted from 1993-1995 aerial photography and M-NCPPC planimetrics, EA 1997.

(6) Area defined by CSPS subwatershed, includes the Potomac River and islands in the river. See Figure 9 for subwatershed boundaries.

(7) Not Available.

Natural Resources and Agriculture in Parkland[1]

Table 4

	Sensitive Areas[2]			Forest [3]			Agriculture [4]		
	Acres of Resource in Watershed	Acres of Resource in Parkland	Percent of Resource in Parkland	Acres of Resource in Watershed	Acres of Resource in Parkland	Percent of Resource in Parkland	Acres of Resource in Watershed	Acres of Resource in Parkland	Percent of Resource in Parkland
Potomac River[5]	3,178-3,394	346	10	526	287	54	0	0	0
Potomac Subregion without River	10,380-11,614	3,959-4,157	36-38	13,657	5,239	38	2,086	136	7
Lower Seneca	1,510-1,707	716-779	46-47	2,497	1,113	45	1,149	133	12
Rock Run	738-825	198-204	25-27	807	210	26	56	0	0
Direct Tributaries	2,138-2,195	1,274-1,280	58-60	2,796	1,672	60	245	1	< 1
Cabin John Creek	1,765-1,982	586-632	32-33	1,812	791	44	0	0	0
Muddy Branch	1,719-1,927	727-762	40-42	2,515	1,004	40	281	2	< 1
Watts Branch	2,510-2,978	452-506	17-18	3,230	449	14	355	0	0
Headwaters									
Cabin John Creek	NA[6]	NA	NA	791	128	16	0	0	0
Muddy Branch	NA	NA	NA	783	76	9	255	0	0
Watts Branch	NA	NA	NA	414	145	35	568	0	0

(1) Resources within *existing* parkland, by watershed. Sensitive areas, forest areas and agricultural areas overlap significantly (e.g., forest may be partially within sensitive areas). The corresponding acres and percent figures in each row should not be summed as this may result in double counting.

(2) Range includes streams, stream buffer area (buffer size ranges from a minimum of 100 feet to a maximum of 150 feet for Use I streams, depending on adjacent slopes), wetlands (NWI data, DNR guidance maps, riparian areas within 15 feet of a stream, and hydric soils), wetland buffers (60 feet for Piney Branch, 100 feet for wetlands of Special State Concern and 25 feet elsewhere), 100-year floodplain (M-NCPPC and FEMA data), and steep slopes (greater than 25%) per 1997 M-NCPPC Environmental Guidelines. See Table A-1, Sensitive Resources, for more detailed information.

(3) GIS coverage of Forest interpreted from 1993-1995 aerial photography and M-NCPPC planimetrics, EA 1997.

(4) GIS coverage of Undeveloped Resources interpreted from 1993-1995 aerial photography and M-NCPPC planimetrics, EA 1997.

(5) Area defined by CSPS subwatershed containing the Potomac River and islands in the river. See Figure 9 for subwatershed boundaries.

(6) Not Available.

Forest[(1)] by Watershed

Table 5

	Watershed Area (Acres)	Total Forest Area (Acres / %)		Deciduous Woodland (Acres / %)		Mixed Woodland (Acres / %)		Coniferous Woodland (Acres / %)		Successional Woodland (Acres / %)	
	Acres	Acres	% of watershed area	Acres	% of forest area	Acres	% of forest area	Acres	% of forest area	Acres	% of forest area
Potomac River	3,394	526	15	513	97	4	1	6	1	3	<1
Potomac Subregion Without River	39,987	13,657	34	11,086	81	1,084	8	540	4	947	7
Lower Seneca	5,776	2,497	43	1,914	77	287	12	110	4	186	7
Rock Run	3,210	807	25	734	91	45	6	23	3	5	1
Direct Tributaries	5,283	2,796	53	2,710	97	38	1	8	<1	40	1
Cabin John Creek	7,654	1,812	24	1,496	83	132	7	108	6	75	4
Muddy Branch	7,732	2,515	33	1,793	71	194	8	112	4	417	17
Watts Branch	10,332	3,230	31	2,439	75	388	12	179	6	224	7
Headwaters											
Cabin John Creek	4,138	791	19	466	59	188	24	69	9	68	9
Muddy Branch	4,899	783	16	536	68	63	8	24	3	161	20
Watts Branch	3,961	414	10	349	84	21	5	3	1	40	10

(1) GIS coverage of Forest interpreted from 1993-1995 aerial photography and M-NCPPC planimetrics, EA 1997. The forest categories used represent generalized forest types recognized by the Maryland state forest inventory.

(2) Area defined by CSPS subwatershed, includes the Potomac River and islands in the river. See Figure 9 for subwatershed boundaries.

(*Quercus stellata*), blackjack oak (*Quercus marilandica*), chinkapin (*Castanea pumila*), sassafras, Virginia pine (*Pinus virginiana*), eastern red cedar, pitch pine (*Pinus rigida*), blueberries (*Vaccinium* spp.), mountain laurel, and huckleberries (*Gaylussacia* spp.).

In several small upland areas, isolated patches of Chestnut Oak association forests occur. These forests are characterized by chestnut oak along with red maple, white oak, sassafras, black cherry , black gum, red oak, black oak (*Quercus velutina*), pignut hickory (*Carya glabra*), flowering dogwood, serviceberries (*Amelanchier* spp.) blueberries, mountain laurel, and root sprouts of American chestnut (*Castanea dentata*).

Wetlands

Based on hydric soil indicators derived from the Soil Survey of Montgomery County (USDA, 1995), approximately 4,900 acres of wetlands cover 12 percent of the Potomac Subregion (EA 1997a). These figures do not include the area of the Potomac River along the south edge of the Potomac Subregion.

The Maryland Non-tidal Wetlands Act (1989) lists several wetlands of special State concern in the Potomac Subregion area: Great Falls Floodplain, Great Falls Natural Heritage Area, and the Violettes Lock Floodplain (see Figures 12 and 17 for the location of these wetlands). Wetlands may be designated nontidal wetlands of special State concern if they provide habitat or ecologically important buffers for the habitat of State or federal rare, threatened, or endangered species, or if they contain unique or unusual natural communities. Wetlands of special State concern are designated by the Maryland Department of Natural Resources and are listed in COMAR 26.23.06.01.

Wetlands in the Potomac Subregion can be grouped into four categories: forested, scrub-shrub, emergent, and open water. Plant communities occurring in wetlands are usually dominated by species such as skunk cabbage and sycamore which are adapted to saturated conditions. Wetlands may also contain species such as tulip poplar, musclewood and multiflora rose (*Rosa multiflora*) which typically occur in drier environments.

Wetlands are located in the stream valleys of the Potomac Subregion, within the floodplains, in low-lying areas beyond floodplain boundaries or at the base of steep slopes. Groundwater pathways supplying base flow to streams in the region occasionally exit from the floodplain, sometimes at the base of steep slopes. These seep areas and other depressed areas close to the water table have developed hydric soils that are capable of supporting hydrophytic (wetland) vegetation.

Forested wetlands are the most common wetland type, comprising 28 percent of total wetland acreage (see Table 6). Tree species typically occurring in forested wetlands include sycamore, green ash, red maple and box elder.

Understory shrubs in the forested wetlands may include natives such as spicebush, blackberry (*Rubus* spp.), arrowwood, musclewood, and non-native species such as Japanese honeysuckle, bamboo (*Phyllostachys* sp.), and multiflora rose.

Emergent, scrub-shrub, and open water wetlands are dominated by a variety of herbaceous and woody species including poison ivy, various unidentified *Carex* species, broom-sedge (*Andropogon virginicus*), reed canary grass (*Phalaris arundinacea*), soft rush (*Juncus effusus*), several species of goldenrod (*Solidago* spp.), rice-cutgrass (*Leersia oryzoides*), cattails (*Typha latifolia*), field mint (*Mentha arvensis*), pickerelweed (*Pontederia cordata*), smartweeds (*Polygonum* spp.), clearweed (*Pilea pumila*), jewelweed (*Impatiens capensis*), asters (*Aster* spp.), fescue (*Festuca arundinacea*), several species of *Rubus*, and larger water-starwort (*Callitrichie heterophylla*).

EA Engineering, Science and Technology, and M-NCPPC evaluated 40 wetland assessment groups[3] in the six major watersheds which comprise the Potomac Subregion (Seneca Creek, Muddy Branch, Watts Branch, Cabin John, Rock Run, and tributaries draining directly to the Potomac River). The wetland assessment group boundaries were developed by the M-NCPPC in cooperation with the Maryland Department of the Environment (MDE). Boundaries were based upon stream order, hydrologic connection, road crossings with extensive embankments and culverts, and significant inflows from tributary streams. The Appendix contains a brief description of the determination of wetland assessment groups and the wetlands functional assessment methodology. **For additional details, see the *Potomac Wetland Functional Assessment Study*, which is a separate appendix incorporated by reference into this report (EA, M-NCPPC, 1997.)**

The five wetland functions assessed for the wetland assessment groups of the Potomac Subregion during this study were:

- **Groundwater Discharge** — areas where flow from the groundwater system reaches the surface. This flow may occur in springs or seeps. Springs are areas of concentrated flow; seeps are areas of saturation.
- **Floodflow Attenuation** — ability of wetlands to hold floodwaters.

[3] A wetland assessment group is a group of wetlands which are hydrologically linked.

Wetlands[1] by Watershed

Table 6

	Water-shed Area	Total Wetland Area		Forested Wetlands(2)		Emergent / Shrub Wetlands		Forested Riparian Wetlands		Open Water / Emergent Wetlands		Emergent / Shrub / Spring Seep Wetlands		Emergent / Shrub Riparian Wetlands		Forested / Spring Seep Wetlands	
	Acres	Acres	% of water-shed area	Acres	% of wet-land area	Acres	% of wet-land area	Acres	% of wet-land area	Acres	% of wet-land area	Acres	% of wet-land area	Acres	% of wet-land area	Acres	% of wet-land area
Potomac River	3,394	3,145	93	381	12	408	13	17	1	419	13	0	0	1,921	61	0	0
Potomac Subregion without River	39,987	4,893	12	1,884	39	1,255	26	456	9	562	11	194	4	371	8	171	3
Lower Seneca	5,776	843	15	414	49	106	13	50	6	113	13	31	4	87	10	41	5
Rock Run	3,210	424	13	148	35	137	32	35	8	17	4	59	14	16	4	14	3
Direct Tributaries	5,283	1,071	20	305	28	148	14	213	20	221	21	17	2	150	14	17	2
Cabin John Creek	7,654	761	10	269	35	324	43	38	5	30	4	38	5	39	5	24	3
Muddy Branch	7,732	719	9	332	46	180	25	66	9	80	11	12	2	21	3	27	4
Watts Branch	10,332	1,075	10	416	39	360	34	54	5	101	9	37	3	58	5	48	4
Headwaters																	
Cabin John Creek	4,138	248	6	58	23	51	20	25	10	50	20	39	16	12	5	13	5
Muddy Branch	4,899	654	13	164	25	223	34	5	1	132	20	89	14	19	3	22	3
Watts Branch	3,961	402	10	134	33	174	43	6	1	38	10	31	8	14	3	5	1

(1) GIS coverage of Wetlands, EA 1997. Includes data from NWI wetlands maps, DNR wetlands guidance maps, M-NCPPC planimetric GIS coverage of streams, riparian areas within 25 feet of a stream, and hydric soils from 1995 *Soil Survey of Montgomery County*.

(2) Categories are adapted from Cowardin, et. al., 1979, *Classification of Wetlands and Deepwater Habitats of the United States.* U.S. Department of the Interior, Fish and Wildlife Service.

- **Sediment Retention/Nutrient Removal** — ability of wetlands to settle sediments or take up nutrients such as nitrogen and phosphorus.
- **Aquatic Habitat** — ability of the wetlands to support plants and animals in the water.
- **Wildlife Habitat** — ability of the wetlands to support a variety of wildlife.

The following conclusions were documented in the *Potomac Wetland Functional Assessment Study* (M-NCPPC and EA Engineering, 1997):

- Park acquisition has protected and preserved many significant wetlands in the Potomac Subregion.

- Instream habitat associated with the forested, scrub-shrub and emergent wetlands is moderately to severely stressed throughout the developed portions of the Potomac Subregion. Streambank erosion, downcutting within the channel, tree loss, extensive deposition and heavy sediment loads were observed during field investigations in these areas. This degradation is affecting adjacent wetlands and vernal pools by altering the natural hydrologic processes of overbank flooding, groundwater discharge to wetlands, and maintenance of stream baseflow.

- The cumulative impacts of sewer line rights-of-way, power lines, and road crossings may present a greater threat to wetlands habitat in the study area than adjacent low-density residential land use. Loss of mature forest canopy, introduction of invasive species, and fragmentation of wetlands and riparian ecosystems was documented during the field investigations. Wetlands adjacent to and within the sewer line rights-of-way are fragmented and often subject to encroachment or disturbance by maintenance or expansion activities.

Descriptions of wetlands characteristics and functions for each watershed are presented later in this chapter under the individual watershed sections. The State requested that priority wetlands be designated as part of this wetlands functional assessment study, as they are for other such studies conducted with State assistance. The criteria for designating "priority wetlands" were developed in consultation with the Maryland Department of the Environment. Priority wetlands are wetlands that receive a high composite score for aquatic and wildlife habitat. These wetlands support a diverse community of animals and plants and deserve special consideration in the master planning process. The use of habitat scores as criteria for designation is consistent with the approach used in the *Countywide Stream Protection Strategy* (CSPS)(MCDEP, 1997), which ranks streams according to biological life and instream habitat.

Habitats of Rare, Threatened, and Endangered Species and Areas Likely to Contain Unusual Biological Communities

The Potomac River long has served as a migration corridor for plant and animal species. The steep slopes above the river have limited disturbance of these areas, as has ownership by the National Park Service. In addition, the river itself modifies the climate near its banks. The combination of these factors has resulted in a high concentration of rare, threatened, and endangered species near the river. In particular, Great Falls National Park is home to many RTE (Rare, Threatened, and Endangered) species.

The probability of finding rare, threatened, or endangered species or unusual biological communities increases in wetland areas, in areas with underlying bedrock types such as ultramafic and diabase rock formations, in areas of serpentine soils, and with increasing proximity to the Potomac River.

Surveys for RTEs species and unusual biological communities have been conducted by the Maryland Department of Natural Resources Heritage and Biodiversity Conservation Program as well as by the M-NCPPC and consultants under its direction. RTE species found in the Potomac Subregion include plant, bird, and invertebrate species (see Table 7 for examples of RTE plant species found in the Subregion).

Areas with more frequent occurrences of RTEs species and unusual biological communities include portions of Seneca Creek State Park and several Montgomery County parks, as well as Great Falls National Park, the C&O Canal National Historical Park, and a large tract of land in the Greenbriar Branch watershed.

The Greenbriar Branch site sits atop a large serpentine soil deposit. Serpentine soils are rich in chromium and magnesium and poor in other essential plant nutrients. The vegetation found in serpentine areas is more tolerant of high levels of soil magnesium and chromium than many other plants. Such areas may be dominated by grasses with pines often interspersed (M-NCPPC 1997a). Serpentine areas provide habitat for many plant and animal species listed as rare, threatened, or endangered. The Greenbriar Branch serpentine area not only contains several RTE plant species, but also supports a biological community which includes post oak, blackjack oak, and pitch pine as significant components. This community is rare in Montgomery County.

The major stream valleys have many of the attributes of the Potomac River: they serve as migration corridors, have

altered microclimates, and have been protected both by topography and by their status as parks. While detailed surveys generally are not conducted on private lands, surveys have been prepared for some County parklands by the Maryland Heritage and Biodiversity Conservation Program. These surveys have identified areas containing RTE species in Cabin John Regional Park, Buck Branch Stream Valley Park, Watts Branch Stream Valley Park, Muddy Branch Stream Valley Park, and Blockhouse Point Conservation Park.

Within Cabin John Regional Park, a site north of Tuckerman Lane and west of I-270, contains four State watchlist plant species and at least five plant species rare to uncommon in the County. Two watchlist species were documented in Buck Branch Stream Valley Park south of Bells Mill Road.

Surveys of Muddy Branch Stream Valley Park have yielded two locations for RTE species. The first site, north of River Road and south of Esworthy Road, contains at least four watchlist plant species. The second site, just south of MD 28, supports two watchlist plants and several other species which are rare to uncommon in Montgomery County.

Blockhouse Point Conservation Park near the Potomac River is home to one watchlist, one State threatened, and one State endangered plant species. In addition, Blockhouse Point Park contains one of the largest undisturbed forest blocks in the Potomac Subregion. This forest provides habitat for forest interior dwelling bird species.

The survey of Watts Branch Stream Valley Park recorded one watchlist plant species south of Glen Road and east of Piney Meetinghouse Road. Additional surveys by the M-NCPPC have added one more watchlist plant species in this same area. In addition, M-NCPPC surveys have found watchlist plant species in two other areas of Watts Branch Stream Valley Park, specifically at a site north of River Road and west of Piney Meetinghouse Road, and at a site between the Glen Road bridge over Watts Branch and the end of Gregerscroft Road. Both sites also contain other plant species rare or uncommon in Montgomery County. Additionally, all three Watts Branch sites serve as habitat for forest interior dwelling bird species, which are of concern nationwide due to declining populations.

Hemlock (*Tsuga canadensis*) stands are located in Seneca Creek State Park near Berryville Road (M-NCPPC 1977). This community type is rare in the Potomac Subregion due to early logging activities and a general lack of micro-climatic conditions necessary for these stands to develop.

Rare, Threatened, and Endangered Plant Species **Table 7**

Scientific Name	Common Name
Asclepias verticillata	Whorled milkweed
Arisaema dracontium	Green dragon
Aristolochia serpentaria	Virginia snakeroot
Aster shortii	Short's aster
Bromus latiglumis	Broad-glumed brome
Carex grayi	Asa Gray's sedge
Carex hitchcockiana	Hitchcock's sedge
Carex shortiana	Short's sedge
Castanea pumila	Chinquapin
Chamaelirium luteum	Devil's-bit
Chrysogonum virginianum	Golden-knees
Clematis viorna	Leatherflower
Cynanchum laeve	Honeyvine
Dirca palustris	Leatherwood
Dodecatheon meadia	Shooting-star
Ellisia nyctelea	Nyctelia
Erigenia bulbosa	Harbinger-of-spring
Erythronium albidum	White trout lily
Eupatorium altissimum	Tall boneset
Gentiana villosa	Striped gentian
Geum vernum	Spring avens
Heuchera pubescens	Downy heuchera
Hibiscus laevis	Halberd-leaved rose-mallow
Hybanthus concolor	Green violet
Krigia dandelion	Potato dandelion
Liparis loeselii	Loesel's twayblade
Matteuccia struthiopteris	Ostrich fern
Melica mutica	Narrow melicgrass
Passiflora lutea	Yellow
Phacelia purshii	Miami mist
Ptelea trifoliata	Water-ash
Quercus imbricaria	Shingle oak
Ranunculus micranthus	Rock crowfoot
Ruellia strepens	Rustling wild-petunia
Scutellaria ovata	Heart-leaved skullcap
Stenanthium gramineum	Featherbells

Wildlife and Fish

There have been few comprehensive wildlife inventories conducted in the study area. There are, however, several wildlife habitats and species known to occur in the study area that should be noted because they are declining regionally or they can have a direct or indirect impact on humans and land development.

Numerous fish surveys have been conducted in various Potomac subwatersheds since the beginning of this century. A list of the fish species found in Potomac Subregion streams as reported in the *Countywide Stream Protection Strategy* is presented in the Appendix (see Table A-2).

Forest Interior and Riparian Forest Habitat

Forest interior dwelling (FID) species, particularly birds, require large tracts of unfragmented woodland to supply their life requisites. Forested areas at least 100 acres in size or riparian (streamside) forests that are at least 300 feet wide provide appropriate FID habitat. As forested land throughout the east and central U.S. has been fragmented by development, FID species have declined dramatically. Approximately 7,174 acres of forest interior habitat have been identified in the study area. The Maryland Breeding Bird Atlas (1983-1987) indicates that many of these areas were supporting FID species. In addition to FID species, undisturbed riparian forests along the Potomac River and on river islands currently support nesting Bald Eagles.

Grassland and Edge Habitat

Current land use in parts of the study area support large areas of grassland and edge habitat. Pasture land, hayfields, sod farms, large estates and golf courses provide grassland habitat for several specialized species of birds that are declining regionally. Species include bluebirds, eastern meadowlarks, grasshopper sparrows, kestrels (a small falcon), and other grassland or open country specialists. The edges where these fields meet other habitats, particularly forest, provide important habitat for other uncommon species including Baltimore orioles, and red-tailed and red-shouldered hawks.

Wildlife Management Concerns

White-tailed deer, beaver, and Canada geese have expanded their range and population size dramatically within the study area over the past decade. These three species have the potential to have direct or indirect impacts on humans and land development.

Increased white-tailed deer populations have resulted in increased deer impacts including deer-auto collisions and damage to farm crops, home landscapes and natural vegetation. The County developed and began implementing a comprehensive deer management plan in 1995 that includes data collection, public education, and implementation of management options including population management. Given the juxtaposition of parkland, housing communities and large estates, deer populations in the area are likely to continue increasing for some time.

Beaver now are present in virtually all stream valleys in the study area. Beaver activities include the cutting of trees and the damming and flooding of small streams, both of which can affect private and public lands. No studies of beaver populations or habitat usage have been undertaken in the study area but casual observations and the monitoring of citizen complaints indicate that sites often are colonized for a short period of time, usually several months to a year before they are abandoned. Most impacts to private property are limited to properties built close to or within floodplains before current environmental guidelines were in effect. Efforts are underway to develop a management plan similar to the County's deer plan that will focus on education and the use of various management options to address impacts on a site-by-site basis. Current environmental guidelines should minimize problems with private landowners.

Large numbers of Canada geese have taken up residence in the County over the past decade. These resident geese do not migrate but spend the entire year in the area. Geese are attracted to areas of open grass with ponds or lakes. Golf courses, parks, institutional properties and large estates can attract large numbers of geese, resulting in problems such as interference with activities including golf, picnicking and swimming, and in waste buildup on land areas and in ponds.

Air Quality

The entire Washington Metropolitan Statistical Area, which includes all of Montgomery County, falls into the "serious" classification for ozone. On average over the past six years, the region has exceeded acceptable federal limits (0.12 parts per million of ozone averaged over one hour) for ozone six days per year. Environmental Protection Agency standards allow regions to exceed acceptable limits only one day per year. The EPA requires attainment of the federal standard by 1999. The Metropolitan Washington Air Quality Committee is responsible for preparing the region's air quality plans and for choosing the air pollution control measures to be implemented by the region.

Local carbon monoxide violations noted in the 1980 air quality plan have been virtually eliminated due to cleaner burning fuels.

Operations at Rockville Crushed Stone Quarry meet air quality requirements of the quarry ordinance.

Noise

The noise generated over a 24-hour period is measured as Ldn. Ldn, the sound pressure level with a penalty for nighttime noise, provides a standard to assess the average noise generated over a 24-hour period. Humans experience increased levels of interference with speech and communication at an Ldn level between 55 and 65 dBA[4].

There are three main sources of nuisance noise in the Potomac Subregion: aircraft noise along the Potomac River, noise from the operating quarries, and traffic-generated noise along major roadways. Stationary noise sources are regulated differently from mobile source noise.

Aircraft-related noise continues to be a nuisance within the Potomac Subregion rather than a health problem. The majority of planes are from National Airport which use the Potomac River as a flight path. Recently completed studies by the Metropolitan Washington Airports Authority indicate that the aircraft-related noise levels are within the limitations set by the Maryland State Aviation Administration for Montgomery County. Continued advances in aviation noise reduction technology may eventually reduce this nuisance.

Noise associated with the four quarries is generally limited to truck traffic accessing the quarries. Truck traffic is restricted to certain haul routes to minimize impacts to residential communities. Occasional blasting of the rock resource is reported to be felt in local homes rather than heard. The Rockville Crushed Stone Quarry on Travilah Road will soon use the new Shady Grove Road south of MD 28 rather than Travilah Road, reducing the noise impact along Travilah Road.

General traffic volume is the most prevalent noise source due to the distribution of roads throughout the Potomac Subregion. The volumes of traffic that use the Capital Beltway (I-495) can exceed 200,000 vehicles per day in certain stretches along the Potomac Subregion boundary. For those heavily traveled portions of the Capital Beltway (I-495) and I-270, the 60 dBA Ldn contour can reach 2700 feet into residential communities along the southwestern boundary of the Potomac Subregion (see Figure 6). The noise barriers that have recently been constructed along most of the Capital Beltway (I-495) near residential areas have significantly reduced noise levels within these communities.

There are, however, a number of heavily traveled State highways and County roads that generate high noise levels that will affect existing and future residential areas.

Noise contours for all major roads were computer-generated using existing levels of traffic (see Figure 6). The noise contour map shows areas where the 60 dBA Ldn contour extends beyond the road right-of-way and rear yard setback for the given zone. The noise models available do not adequately describe the influence of noise barriers.

Noise modeling highlighted areas that have sufficient volumes of traffic in areas with denser zoning that permits housing close enough to the road to be affected. Significant impacts could occur for the roadways listed below given the number of existing and proposed residential lots within the noise impact area. The figures in parentheses indicate the distance from the road subject to noise above 60 dBA. The distances vary due to changes in traffic mix, volume, and speed.

- MD 28 from Darnestown to Shady Grove Road (108-402 feet)
- Falls Road (108-306 feet)
- River Road from Piney Meetinghouse Road to Capital Beltway (I-495) (173-279 feet)
- Democracy Boulevard from I-270 to Falls Road (179-200 feet)
- Tuckerman Lane from I-270 to Falls Road (195-300 feet)

Water and Sewer Service and Capacity

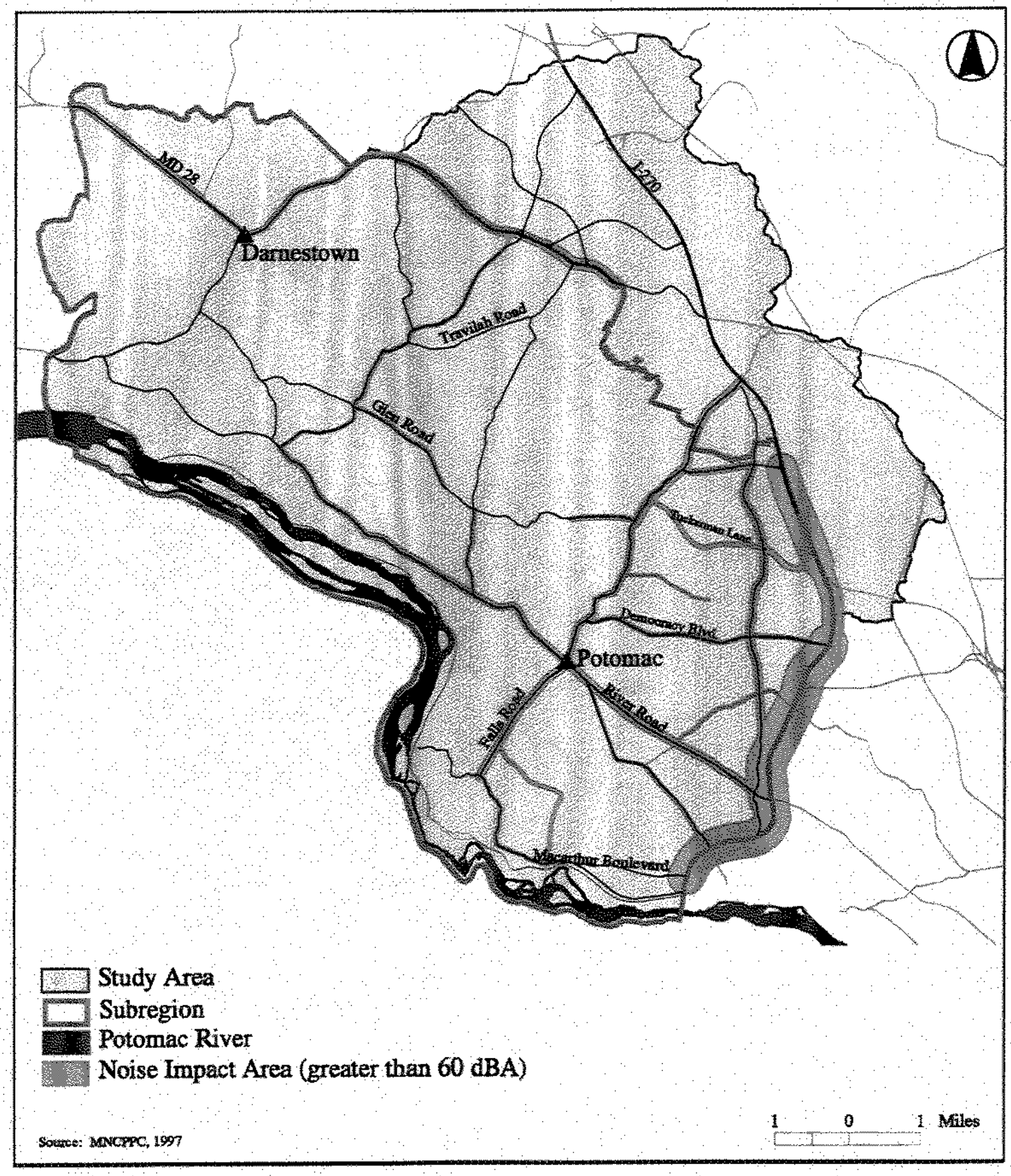
Community sewer service is provided to most of the southern and eastern portions of the Potomac Subregion[5] (see Figure 7). This service is provided via one of four sewer trunk lines: Muddy Branch, Watts Branch (including the Piney Branch sewer), Rock Run, and Cabin John. These trunk lines convey flows from the Potomac Subregion and other planning areas south into the Dulles Interceptor. The Dulles Interceptor is a very large trunk sewer that captures sewage flows from much of Montgomery County and parts of Loudoun and Fairfax counties in Virginia and discharges to the Blue Plains treatment plant in the District of Columbia where much of the region's wastewater treatment needs are met. Various regional agreements detail the average and peak flow limits each jurisdiction is allowed to discharge into this system.

[4] A measure of decibel levels, weighted (using "A" weighting) for sounds that affect the human ear.

[5] Detailed information on sewer and water service categories can be obtained from the Montgomery County Department of Environmental Protection.

Traffic Noise Impact Areas

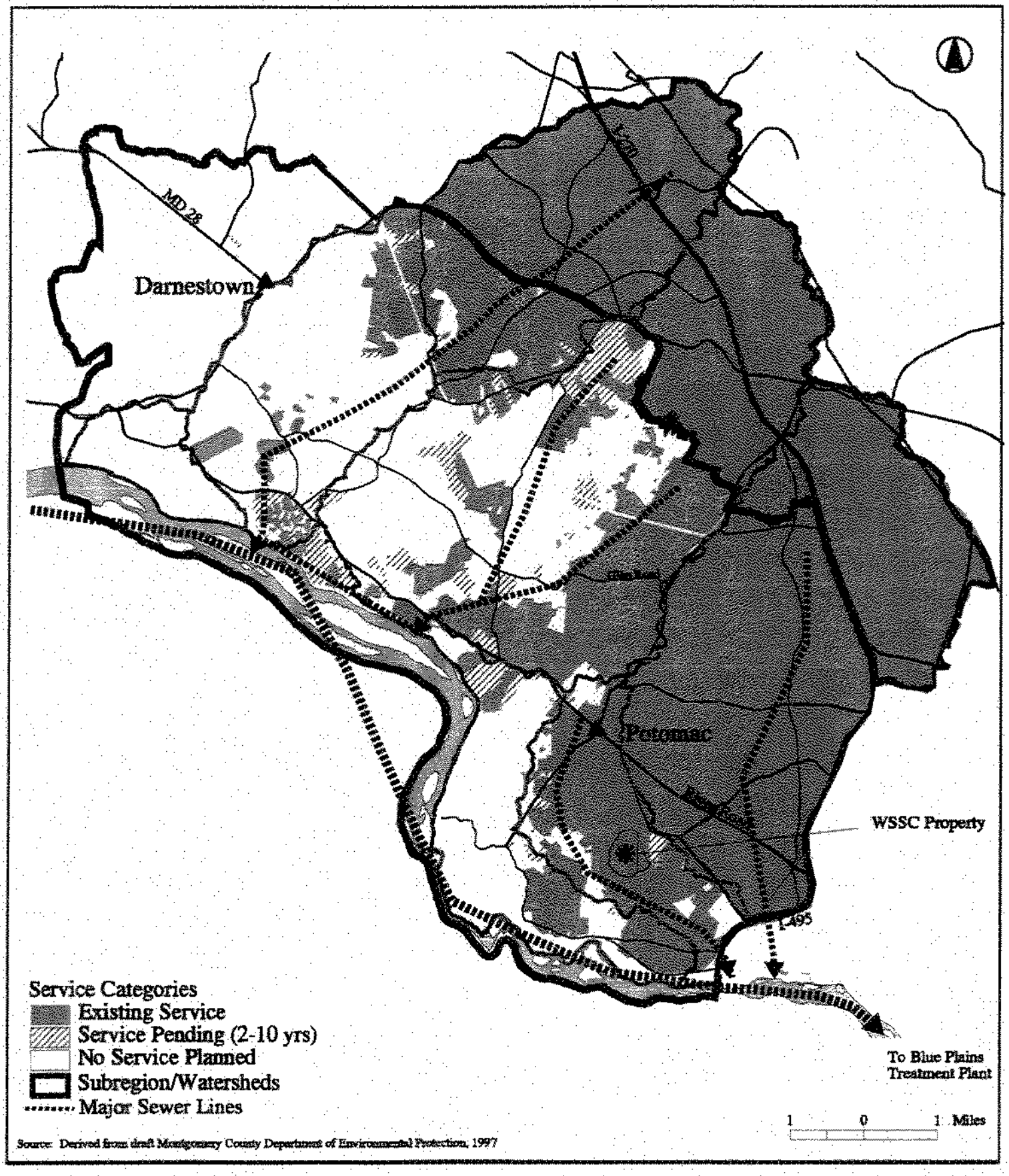
Figure 6



Source: MNCPPC, 1997

Sewer Service Areas

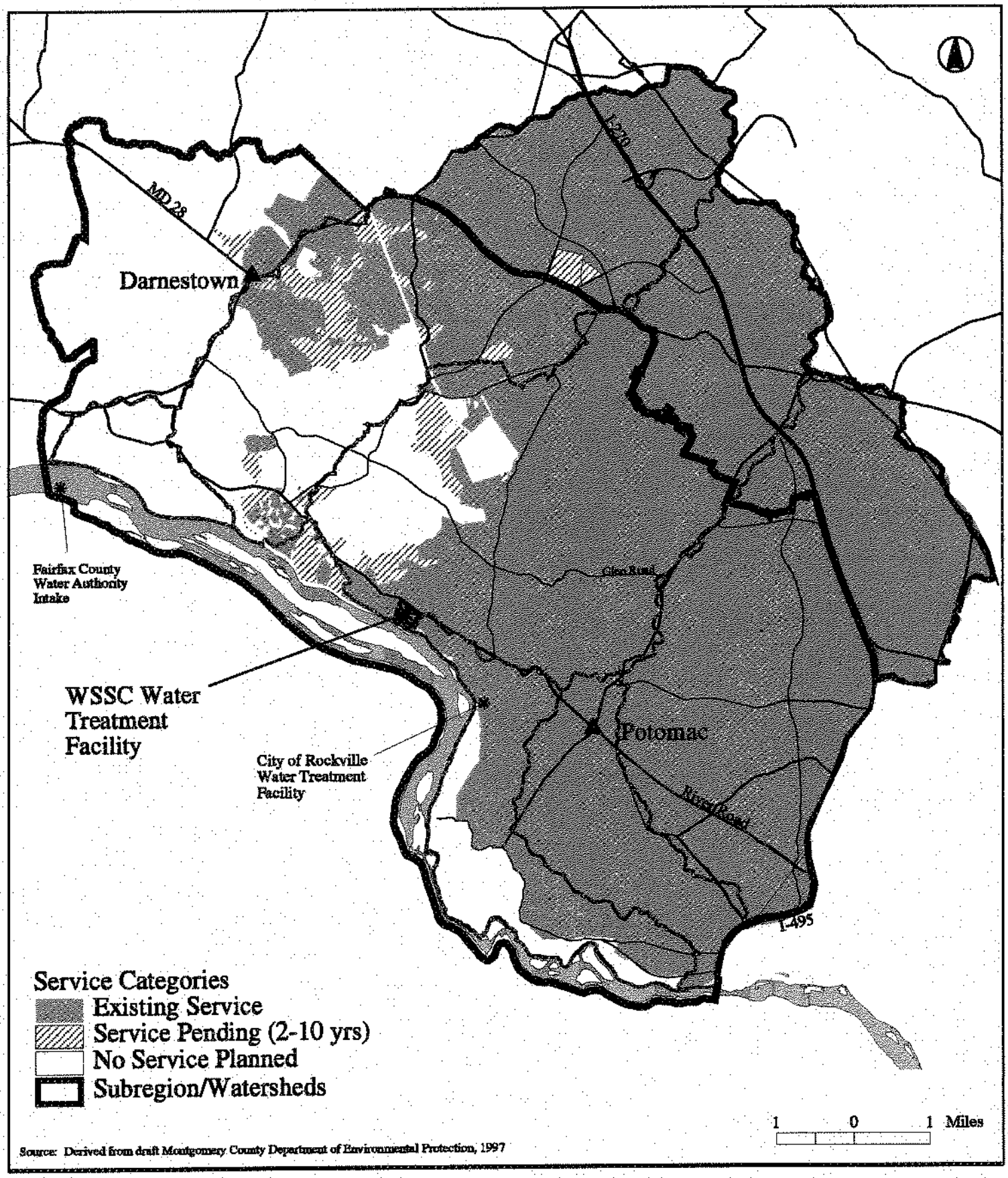
Figure 7



Source: Derived from draft Montgomery County Department of Environmental Protection, 1997

Water Service Areas

Figure 8



Source: Derived from draft Montgomery County Department of Environmental Protection, 1997

Community water service is provided to much of the Potomac Subregion by a network of water supply lines maintained by the Washington Suburban Sanitary Commission (WSSC) (see Figure 8). Raw water is taken from the Potomac River at the water treatment plant located on River Road. WSSC also has a water treatment plant located in Laurel, MD, which receives raw water from the Rocky Gorge reservoir. Together these two plants supply drinking water to the majority of Montgomery and Prince George's counties.

The city of Rockville owns and operates a water treatment facility at the southern terminus of Sandy Landing Road. This plant supplies the drinking water for the Rockville Sanitary District, which includes the city of Rockville. This plant should continue to serve the needs of the Rockville Sanitary District for the foreseeable future. The Fairfax County Water Authority also operates raw water intakes on the Virginia side of the Potomac at the confluence with Seneca Creek.

For a detailed discussion of water and sewer in the Potomac Subregion, see the Water and Sewer Status Report in the Appendix, prepared by M-NCPPC, WSSC, MCDEP, and MCDPS.

Sewer System Capacity

Within the Potomac Subregion area, the Muddy Branch and Cabin John trunk sewers can be expected to exceed designed capacities in portions of their length by the year 2010, which is within the lifetime of the upcoming master plan revision. Additionally, the WSSC portion of the Watts Branch trunk sewer downstream of the city of Rockville may need relief after the year 2020. The actual timing and techniques used to address these sewer capacity concerns will be dependent on the actions of the County Council through the Water and Sewer Plan and the WSSC capital improvement program.

The Sandy Branch pump station is located in the headwaters of the Sandy Branch watershed and collects sewage flow from the area zoned R-200/TDR-3 on the north and south side of Travilah Road at the intersection with Dufief Mill Road. This pumping station, and the Rich Branch trunk sewer to which it feeds, is approaching capacity. In reviewing two recent map amendments to the *Comprehensive Water Supply and Sewerage Plan* (Water and Sewer Plan) located within the pump station sewershed, the County Council raised its concern over the need for an analysis of the capacity problem. The Montgomery County Department of Environmental Protection (MCDEP) and WSSC are studying at the remaining capacity in these two sewerage systems to allow the area to continue developing as a receiving area for the Transfer of Development Rights (TDR) program. Should there be a need to enlarge the existing Sandy Branch wastewater pumping station or provide relief for the Rich Branch trunk sewer, the environmental and community impacts associated with these projects will be examined through the WSSC's facilities planning process.

The WSSC is currently undertaking a major facility plan to address network capacity constraints within the Rock Creek sewerage basin. A possible option under consideration is the pumping of excess flows from Rock Creek over to the Cabin John Creek sewerage basin. If selected, this option will have an impact on the extent and timing of relief sewer construction required in the Cabin John Creek basin.

The WSSC *Strategic Sewerage Study* (WSSC, 1993) identifies the Rock Run wastewater treatment plant as a critical element for the region's future sewage treatment needs in all the alternatives considered in the study. A site for the sewage treatment plant has been designated and documented in the *1980 Potomac Subregion Master Plan*. A study is underway to conduct a preliminary investigation of influent/effluent alternatives and environmental issues, to develop planting and screening schemes, and to develop a long-term implementation schedule.

Water Treatment

The WSSC Potomac water filtration plant is located on River Road. The plant's water intakes are located in the Potomac River immediately downstream of the Watts Branch. The plant provides almost all of the community water supply needs for Montgomery County.

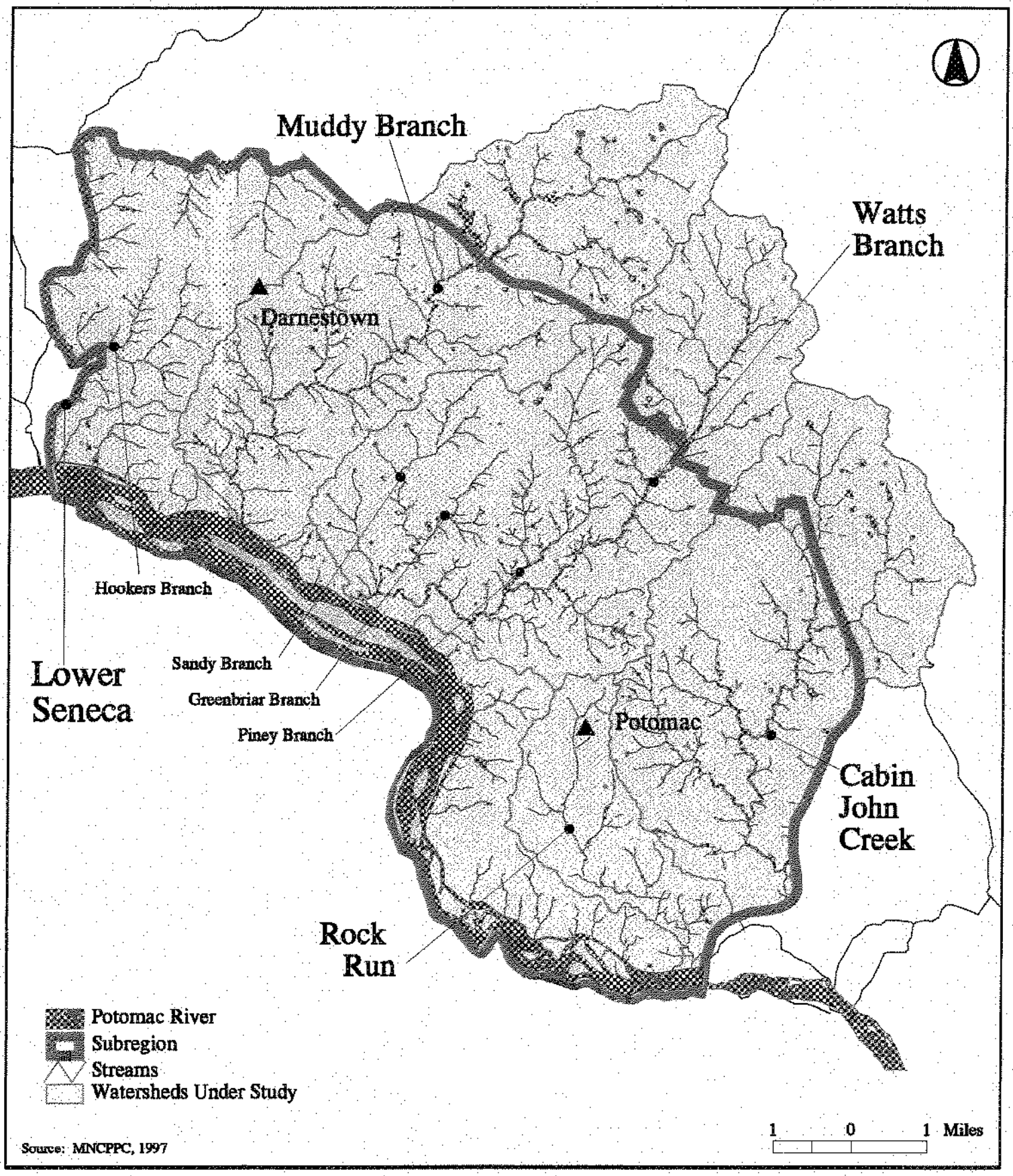
In recent years, the Maryland Department of the Environment (MDE) has expressed concerns about the release of solids filtered from the drinking water treatment process into the Potomac River. Earlier this year, the WSSC and the MDE signed a consent agreement that includes provisions for separating the filter backwash and discharging it directly back to the Potomac River. The agreement also has provisions for pumping, thickening, dewatering, and disposing of the sedimentation solids. The agreement includes a compliance schedule that requires the WSSC to build the facilities necessary to comply with the conditions of the new permit within five years from the date of issuance.

The Potomac River

As the largest body of water in Montgomery County , the Potomac River is a unique resource. The river's watershed is very large, covering portions of Pennsylvania, Virginia, West Virginia, Maryland, and all the District of Columbia (Washington Metropolitan Council of Governments [WMCOG] 1987). All the 68 square miles of the Potomac Subregion drain to the Potomac River, yet the subregion

Potomac River and Tributary Streams

Figure 9



Source: MNCPPC, 1997

constitutes less than one percent of the total watershed of the river.

Because the river is less sensitive to development than the individual tributary watersheds in the Potomac Subregion, the majority of this report focuses on the conditions of the tributary watersheds. However, the river has a definite influence on the plants and animals that are present in the Potomac Subregion.

The importance of the river is evidenced by the following designations:

- Area of Critical State Concern (Maryland Office of Planning, 1981)
- State Scenic River (Maryland Department of Natural Resources, 1991)
- Nomination for American Heritage River designation (1997)

Over the period 1977 to 1985, the Potomac River in the vicinity of the Potomac Subregion has experienced improving water quality (using phosphorus and nitrogen concentrations as a measure) (WMCOG 1987, MDE 1988). The water quality of this section of the river was characterized as good in 1994 (Garrison 1994). Wastewater treatment and stormwater quality management instituted by local jurisdictions have been credited with these improvements (WMCOG 1987). The *Countywide Stream Protection Strategy* does not report current data for the Potomac River. Sensitive areas adjoining the river are depicted on the maps of major watersheds in the sections of this chapter that follow.

The Potomac River several miles east of the Potomac Subregion (in the vicinity of Little Falls Dam), has an average annual discharge of 10,790 cubic feet per second and is the source of drinking water for the cities of Washington, D.C; Rockville, MD; Fairfax, VA; and diffuse areas served by the Washington Suburban Sanitary Commission and the Fairfax County Water Authority (James et al. 1993).

The Potomac River and the parkland bordering it provide many recreational opportunities, including boating, canoeing/kayaking, fishing, wildlife observation, and hiking and biking along the towpath of the C&O Canal. Additional recreational opportunities including picnicking and birdwatching are available at Great Falls National Park. Both parks are part of the National Park System and provide recreational opportunities for individuals who live in and outside the Potomac Subregion. In addition, the C&O Canal National Historical Park and Great Falls National Park provide habitats for the highest concentration of rare, threatened, and endangered species of plants and animals in Montgomery County.

Tributary Watersheds of the Potomac Subregion

The major streams of the Potomac Subregion include (from west to east) parts of Seneca Creek, Muddy Branch, and Watts Branch, all Rock Run, and parts of Cabin John Creek (see Figure 9). The headwater portions of Muddy Branch and Watts Branch are wholly contained in the portion of the study area outside the Subregion. In addition, portions of the Cabin John headwaters are contained in the study area, although other parts of the watershed extend out of the study area east of I-270.

The headwaters of the major streams within the study area are largely developed. The lower portions of the streams generally have less development and have steep-sided valleys and a wide floodplain. Many of the stream valleys in the Potomac Subregion are within parkland owned and regulated by government and other organizations (e.g., M-NCPPC, State of Maryland). Floodplain areas are largely undeveloped with the exception of utility lines. Wetlands are often present within the floodplain and may extend beyond floodplain boundaries.

The Department of Environmental Protection (DEP) as part of the *Countywide Stream Protection Strategy* (CSPS) developed a biological monitoring program that assessed all County streams according to the same methodology (MCDEP in cooperation with M-NCPPC, 1997). The conditions in streams of the Potomac Subregion range from good to poor (see Figure 10). Based on these assessments and projections of potential development (with existing zoning), management categories were assigned for each subwatershed (see Figure 11). For each management category, a set of management tools is identified to address the stream conditions and anticipated levels of development. The management categories and tools provide a basis for targeting interagency resources to address stream quality problems using a focused, watershed approach. The Appendix contains a detailed description of the management categories from the CSPS.

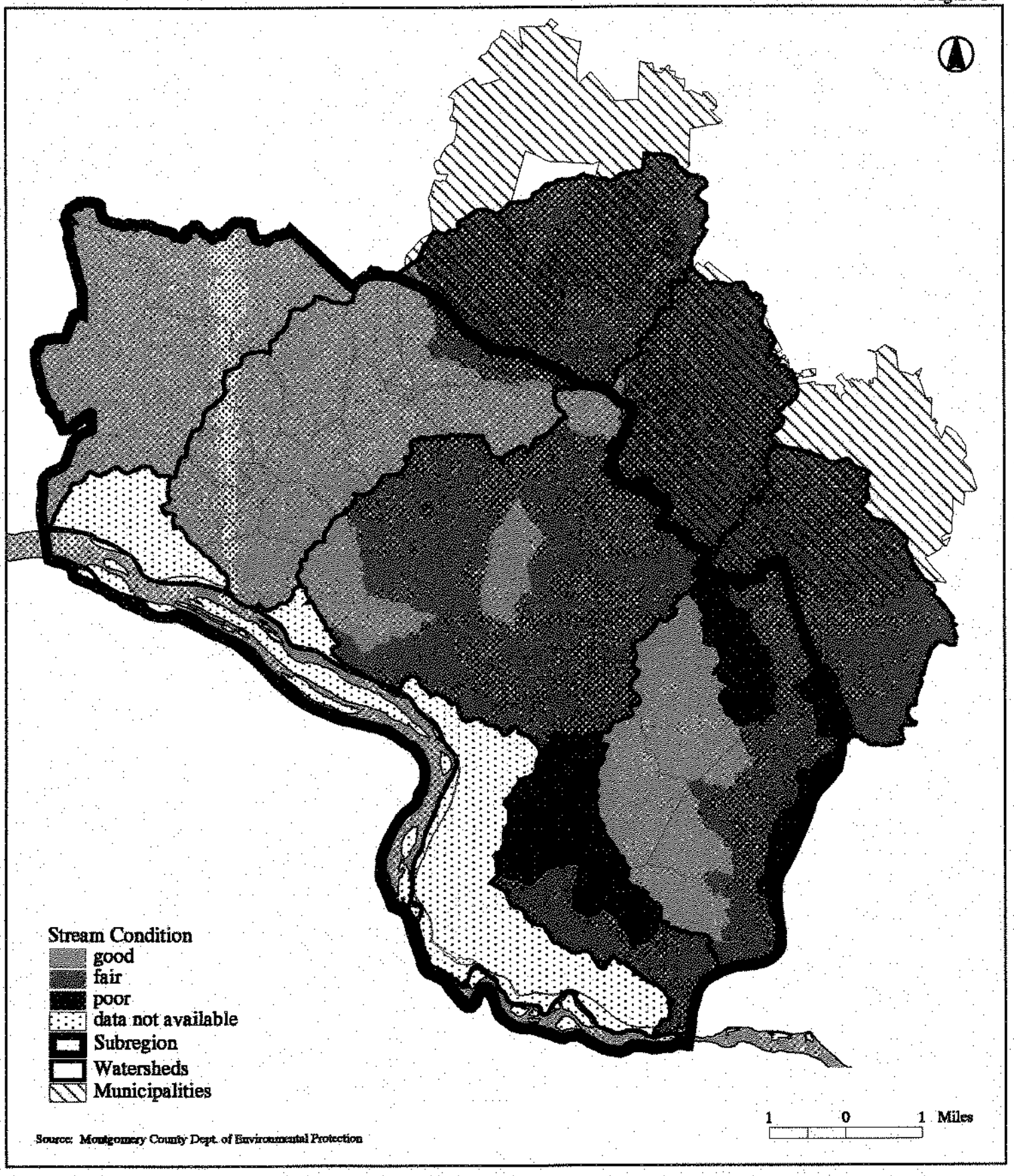
Lower Seneca

Watershed Character

Although the Seneca Creek watershed covers 128 square miles, or 27 percent of Montgomery County, the drainage area in the Potomac Subregion is only about nine square miles or 5,776 acres. Seneca Creek is the largest watershed wholly within the County. Due in part to the size of its watershed, Seneca Creek takes on the character of a small river as it approaches its confluence with the Potomac. For purposes of this report, the portion of the Seneca Creek watershed in the study area is called Lower Seneca.

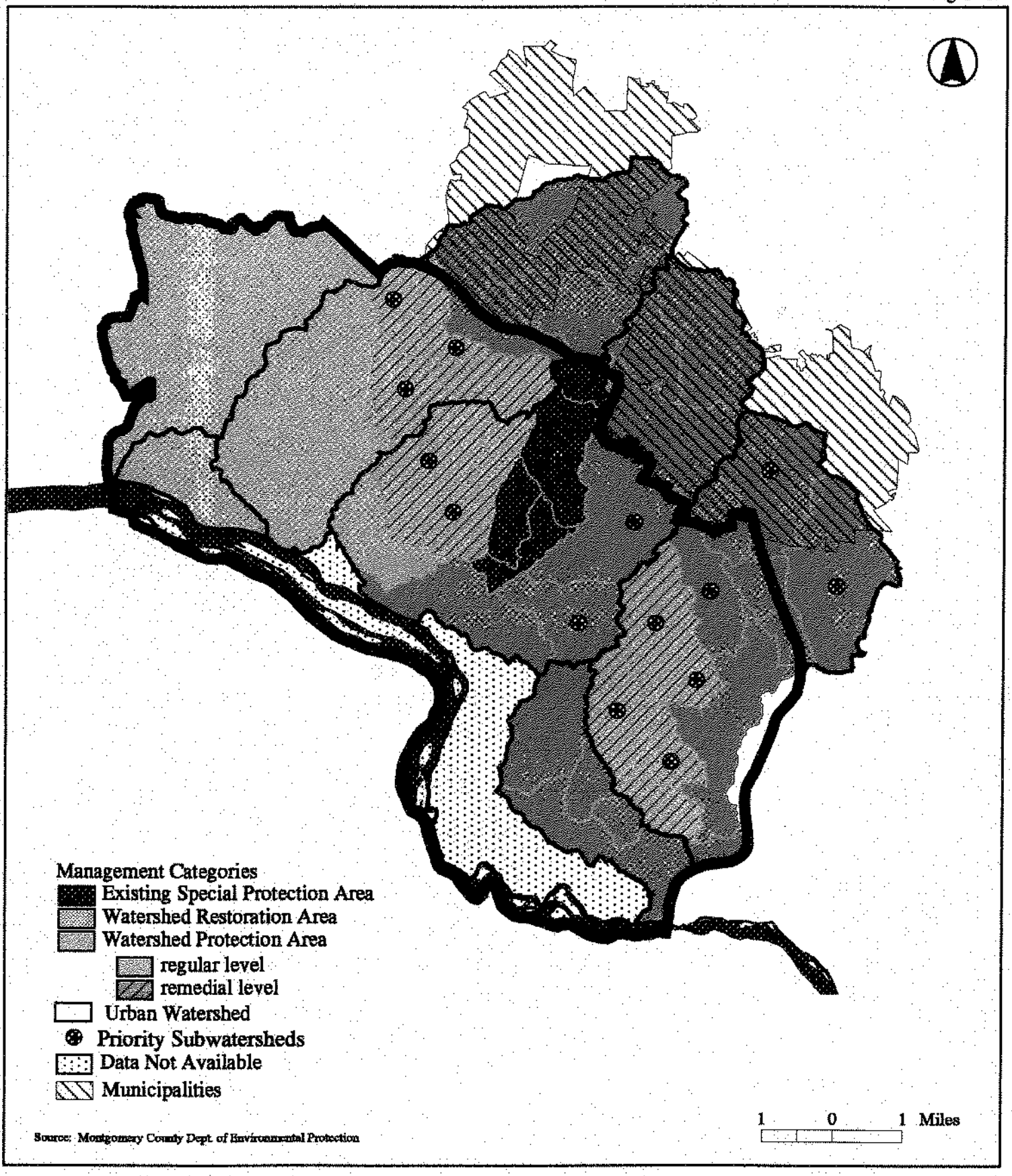
Countywide Stream Protection Strategy - Subwatershed Condition

Figure 10



Countywide Stream Protection Strategy - Management Categories

Figure 11



The Lower Seneca watershed is the most rural of the watersheds in the Potomac Subregion. The rolling landscape is dominated by farm fields and woodlots, punctuated by large-lot developments. The stream valley, which is largely within Seneca Creek State Park, contains extensive areas of mature upland and floodplain forests. Imperviousness in the portion of the watershed in the Potomac Subregion ranges from 4 to 11 percent (see Table A-4 for detailed information about subwatershed imperviousness).

Within the Potomac Subregion, the Lower Seneca watershed contains approximately 2,500 acres of forest (EA 1997a). Upland forests are predominantly oak and hickory. Tulip poplar dominates on some moist slopes and well-drained bottomlands. Wetter portions of the stream valleys support stands of sycamore, box elder, green ash, and red maple. A significant stand of eastern hemlock, rare in Montgomery County, occurs in the park just west of Berryville Road (see Figure 5). This watershed has large unfragmented stands of woodland that provide quality habitat for various wildlife species, including forest interior-dwelling birds.

Water Quality

Current Conditions

The *Countywide Stream Protection Strategy* (CSPS) characterized the portion of Seneca Creek in the Potomac Subregion as fair to good for stream habitat conditions (MCDEP 1997)(see Figure 10). Areas lower in the watershed are in better condition than the headwater sections draining urbanized areas of Shady Grove and the city of Gaithersburg.

The Appendix contains a summary table of past and present water quality monitoring (see Table A-5).

Historical Data

In 1976, a concept plan containing a summary of water quality information for Seneca Creek for a period ending in 1972 presented an overview of water quality conditions in the Seneca Creek watershed (M-NCPPC, 1976). The report concluded that Seneca Creek generally did not have water quality problems related to dissolved oxygen, pH, turbidity, temperature, nutrients (nitrates and phosphates), and biochemical oxygen demand. However, the report indicated that none of the streams in the Seneca Creek watershed met the fecal coliform standard at all times.

From 1977 to 1985, Seneca Creek experienced a statistically significant trend of degrading water quality on the basis of total suspended solids (TSS) and fecal coliform (Maryland Department of the Environment [MDE] 1988). This trend appears to have stabilized, as the levels of TSS and fecal coliform decreased significantly between 1985 and 1987 (MDE 1988). Data for subsequent years indicate slightly elevated levels of TSS and fecal coliform (MDE 1991, 1994), but do not provide sufficient information to determine if the trend is increasing or decreasing. The improved water quality is evidenced by the reported health of the benthic macroinvertebrate community. Surveys completed over the years 1989-1993 indicate good, unimpaired habitat with a moderately impaired aquatic community (MDE 1991, 1994).

Interpretation of Trends

Water quality information available for the portion of Seneca Creek in the Potomac Subregion indicates that from 1977 through 1985, decreasing water quality was documented based on total suspended sediment and fecal coliform (MDE 1988). Prior to this period, water quality was characterized as good even though all streams failed the fecal coliform standard at times (M-NCPPC 1976). There was insufficient data to evaluate trends in stream biological resource conditions.

Sensitive Areas and Wetlands

Sensitive areas are defined by the 1992 State Planning Act as streams and their buffer; 100-year floodplains; steep slopes; and habitats of rare, threatened, and endangered species. For the purposes of this report, wetlands are also considered sensitive areas and are included in the relevant maps and tables. These features generally are contained within the stream valleys and in Lower Seneca are largely within parkland (see Figure 12).

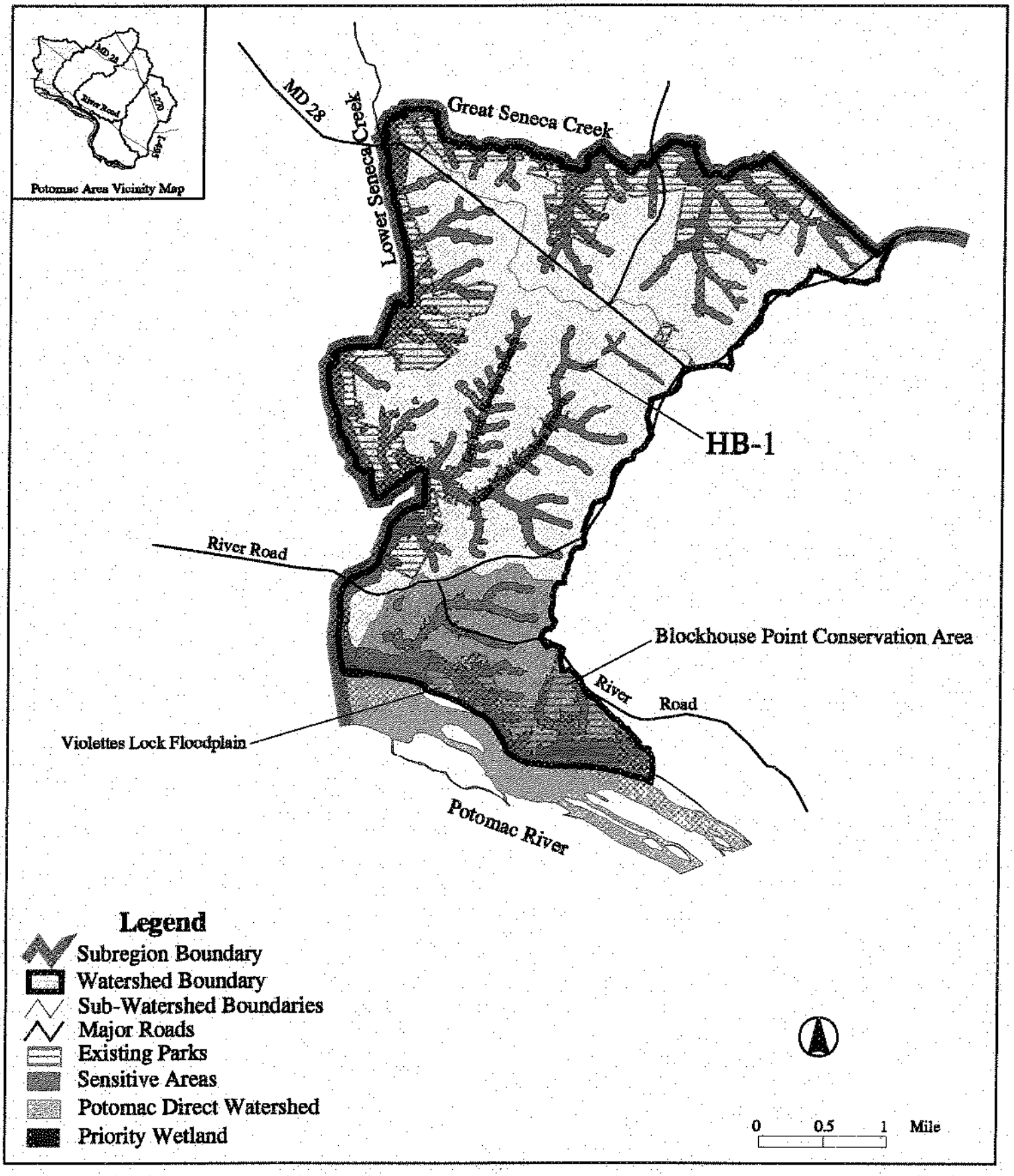
Wetlands are generally associated with the streams and floodplains in the watershed, and may extend beyond the floodplain. The Lower Seneca watershed within the Potomac Subregion has approximately 840 acres of wetlands (EA 1997a).

According to the 1981 National Wetland Inventory (NWI) maps, the dominant wetland types in the Lower Seneca watershed within the Potomac Subregion are forested, emergent, and open water wetlands. Most of the wetlands along the mainstem of Seneca Creek are located on State parkland.

Only one major tributary stream to Seneca Creek, Hookers Branch, is wholly within the study area. The Hookers Branch subwatershed contains high-quality headwater wetlands, excellent in-stream habitat, large areas of mature forest, and little fragmentation caused by roads and utilities. Of the four wetland assessment groups evaluated in the Potomac Wetlands Functional Assessment Study, only two were identified as having wetlands sufficient for scoring.

Lower Seneca Sensitive Areas

Figure 12



The headwaters of the right and left fork of Hookers Branch contain extensive areas of emergent and forested wetlands dominated by skunk cabbage (*Symplocarpus foetidus*), jewelweed, arrow arum (*Peltandra virginica*), sedges, black willow (*Salix nigra*), red maple, and spicebush. The wetland group HB1, headwater wetlands on the right fork above Meadowspring Road, was identified as a priority wetland.

Floodplain associated with the mainstem of Seneca Creek in the planning area is mostly contained within parkland. Known and estimated 100-year floodplain outside parkland includes areas associated with tributaries to the mainstem (e.g. Hookers Branch), and land between River Road and the Potomac River in the vicinity of the Bretton Woods Country Club.

Detailed floodplain studies of the Seneca Creek watershed were conducted in the late 1970s and early 1980s. In a 1983 report, CH2M-Hill (a consultant to the M-NCPPC) identified a number of structures and roadway crossings at risk of flooding and characterized the flooding problem near the confluence of Seneca Creek with the Potomac River as severe. The CH2M-Hill report confirmed the findings of an earlier study of Seneca Creek and Muddy Branch (M-NCPPC 1976), which had identified flooding problems in the same vicinity.

Muddy Branch

Watershed Character

The Muddy Branch watershed is urbanized in its headwaters, and suburban and reral in the Subregion. Substantial development occurs along the MD 28 corridor, as well as north of the Potomac Subregion in Gaithersburg. Other portions of the watershed, particularly in the southern and western areas, remain dominated by small farms and large lots, retaining a more rural character. A significant feature of this watershed is the amount of parkland present. These largely wooded areas contribute much to the rural feel of the watershed west of the PEPCO power line right of way, and serve as home to deer, wild turkey, and countless other birds, mammals, reptiles and amphibians. Larger forest blocks shelter forest interior-dwelling species.

Imperviousness in the Muddy Branch watershed ranges from 5 to 23 percent in the Potomac Subregion (see Table A-4 for additional details about subwatershed imperviousness).

Approximately 2500 acres of forest are present in this watershed within the Potomac Subregion (EA 1997a); (see Table 3). Most of this is relatively mature deciduous forest found in association with the stream valleys and adjacent uplands. Tree species include sycamore, red maple, black walnut, box elder, willow, tulip poplar, sycamore, green ash, river birch, white oak, hickories, American beech, red oak, dogwood, southern red oak (*Quercus falcata*), pin oak (*Quercus palustris*), and musclewood.

Water Quality

Current Conditions

In 1996, in support of the CSPS study, the Montgomery County Department of Environmental Protection monitored four mainstem stations between River Road and MD 28. The CSPS characterized the biological stream condition of Muddy Branch as fair in the city of Gaithersburg just north of the Potomac Subregion, with good stream conditions occurring within the Potomac Subregion (see Figure 10). The stream habitat condition mirrors the biological stream condition. Past and present water quality studies are summarized in Table A-6. Muddy Branch was included in the County's baseline monitoring in 1997 with a watershed report due to the Maryland Department of Environment in winter, 1998.

A study of the stream resource quality for the portions of Muddy Branch and its tributaries located in the city of Gaithersburg concluded that of the 10 stations evaluated, 6 scored fair, 2 scored good, and 2 scored poor (EQR 1996). The most significant feature limiting the quality of these streams was identified as uncontrolled stormwater runoff from portions of the city of Gaithersburg developed prior to the requirement for stormwater management controls.

Historical Data

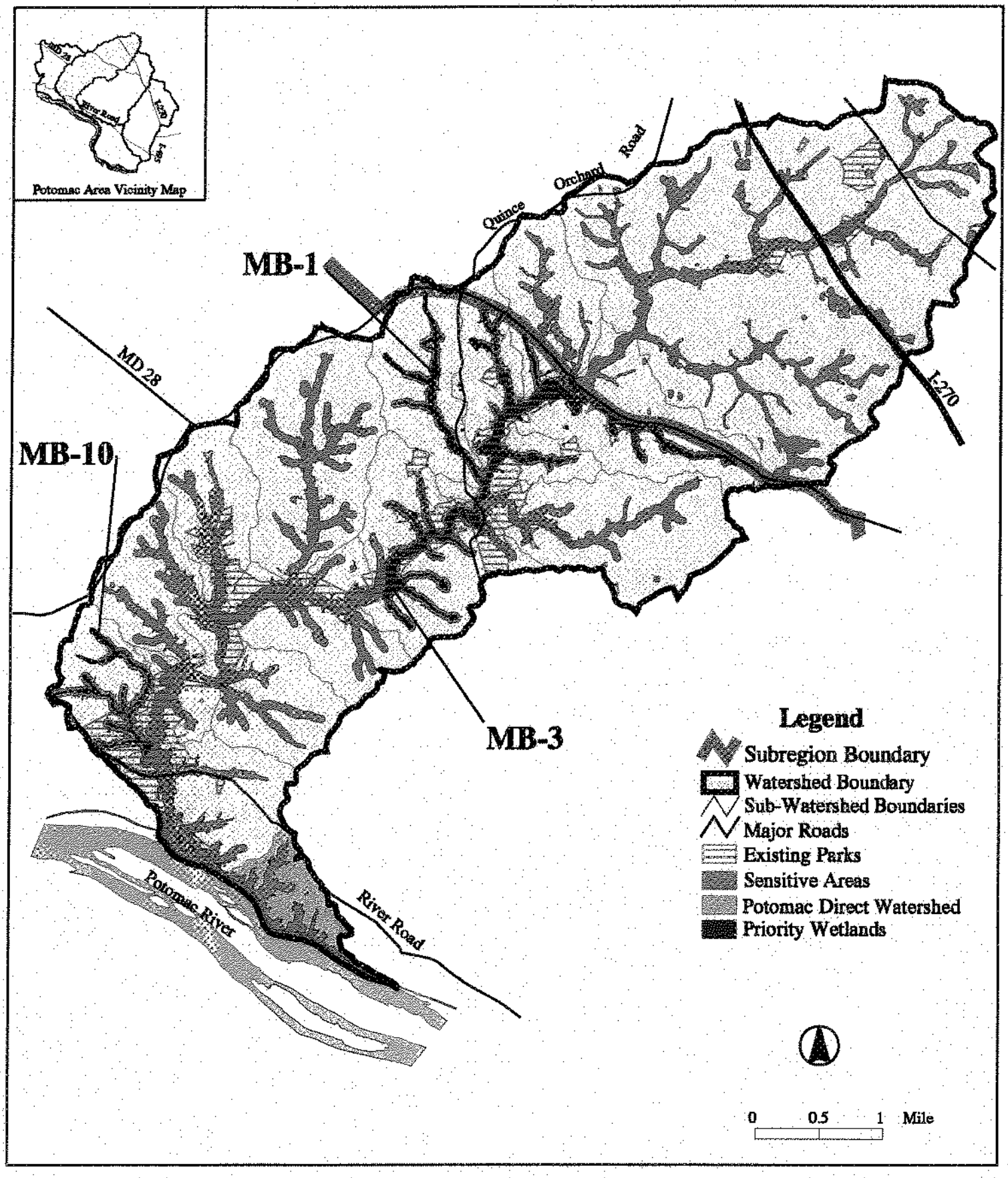
In 1976, a concept plan presented an overview of water quality conditions in the Muddy Branch watershed (M-NCPPC 1976). The plan contained a summary of water quality information for Muddy Branch for a period ending in 1972. The 1976 report concluded that Muddy Branch generally did not have water quality problems with dissolved oxygen, pH, turbidity, temperature, nutrients (nitrates and phosphates), or biochemical oxygen demand. However, this report indicated that none of the streams in the Muddy Branch watershed met the fecal coliform standard at all times.

Benthic macroinvertebrate sampling performed by the Maryland Department of Natural Resources (DNR) in 1991 at two locations on Muddy Branch (Esworthy Road and American Way) and Rich Branch, a tributary to Muddy Branch (Rich Branch Court), yielded Hilsenhoff Biotic Index (HBI) scores of excellent, good, and very good, respectively (Rivers, 1996).

Muddy Branch was categorized as having unimpaired stream habitat and a moderately impacted biological community (Maryland Department of the Environment [MDE] 1993, Garrison 1994).

Muddy Branch Sensitive Areas

Figure 13



Sensitive Areas and Wetlands

Sensitive areas are defined by the 1992 State Planning Act as streams and their buffers; 100-year floodplains; steep slopes; and habitats of rare, threatened, and endangered species. For the purposes of this report, wetlands also are considered sensitive areas and are included in the relevant maps and tables. These features generally are contained within the stream valleys and in the Muddy Branch large portions are within parkland (see Figure 13).

The Muddy Branch has approximately 719 acres of wetland areas within the Potomac Subregion (EA 1997a). The wetland areas in this watershed are often interrupted by road crossings, utility rights-of-way, and sewer line easements.

The National Wetland Inventory maps for this watershed depict forested, emergent, and open water wetlands as the dominant wetland types. The wetland assessment groups of the Muddy Branch watershed range from broad wetlands with additional areas of forest cover to narrow wetlands encroached upon by residential development and utility rights-of-way. Ten locations in the Muddy Branch watershed were evaluated for wetland function. The functional scores for the wetlands in the Muddy Branch watershed range from low to high, with the exception of the groundwater discharge function, which was in the moderate range. The variable scores reflect differences in wetland size, diversity of wetland vegetation, adjacent land use and other factors. Three wetland assessment groups were identified as priority wetlands based on the high composite scores for aquatic and wildlife habitat. They are:

- MB1 — mainstem and tributaries of Muddy Branch downstream of Darnestown Road to Rich Branch.
- MB3 — mainstem and tributaries of Muddy Branch east of Quince Orchard Road to Turkey Foot Road.
- MB10 — tributary east of Signal Tree Lane to its confluence with the mainstem of Muddy Branch.

Floodplain associated with the mainstem of Muddy Branch in the Potomac Subregion is contained within parkland. Known or probable 100-year floodplain areas outside parkland are associated with tributaries to the mainstem, and a portion of the mainstem outside the Potomac Subregion between MD 28 and Great Seneca Highway.

A detailed floodplain study of Muddy Branch identifies several flooding problems located primarily at roadway crossings with the mainstem (M-NCPPC 1976). The locations are depicted on the Water Resources Map of Montgomery County (M-NCPPC 1988).

Watts Branch Mainstem

For purposes of this report, the Watts Branch watershed is divided into four major subwatersheds (see Figure 9). The Watts Branch mainstem is the largest, flowing from the city of Rockville to the Potomac River. The Piney Branch, Greenbriar Branch, and Sandy Branch are larger tributaries that flow into the mainstem south and west of Glen Road. Descriptions of these subwatersheds begin on p. 37.

Watershed Character

Watts Branch is a watershed in transition. While much of the northern and eastern parts of the watershed have been developed for a number of years, significant portions of the northern and central watershed are currently under development. In addition, the large King Farm property in the Watts Branch headwaters in the city of Rockville is also undergoing development. The CSPS estimates that imperviousness in the upper Watts Branch watershed ranges from 22 to 33 percent, indicating a fairly intense level of development (see Appendix Table A-4 for detailed information on imperviousness). This portion of the Watts Branch watershed is beyond the boundaries of the Potomac Subregion, but has an impact on the stream within the Subregion.

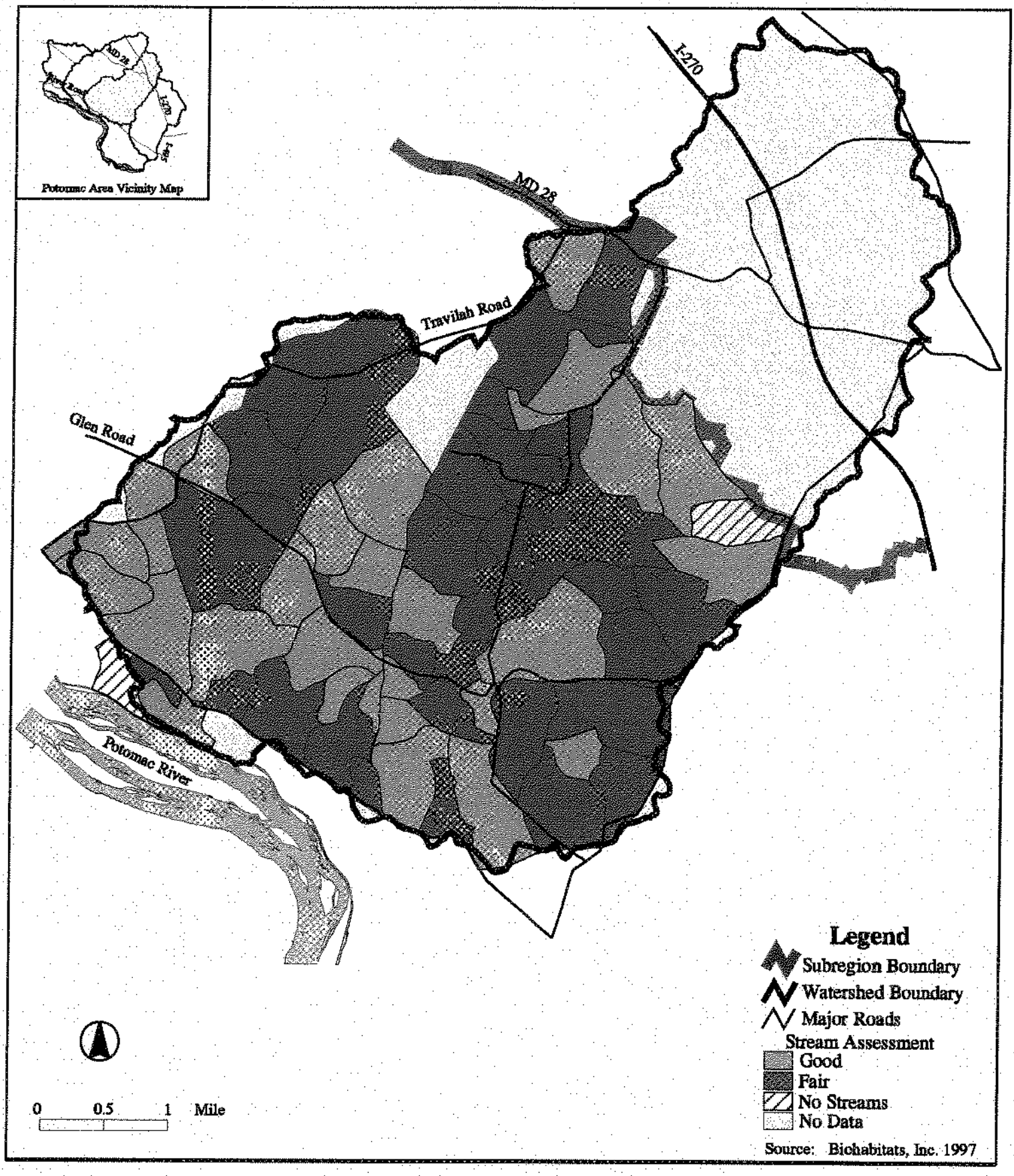
Meanwhile, the southern and western portions of the watershed remain relatively undisturbed, featuring a mix of small farms and large-lot development that has remained for many years. Current estimates reported in the CSPS for subwatersheds in this area range from 6 to 16 percent impervious.

As in the Seneca Creek and Muddy Branch basins, parkland is a central feature in the Watts Branch drainage area. Watts Branch Stream Valley Park shelters the Watts Branch mainstem and associated resources within the Potomac Subregion. Sensitive species of plants and animals are protected within the park's borders.

There are approximately 3,200 acres of forest in the Watts Branch watershed within the Potomac Subregion. These are predominantly deciduous forests, dominated by oak tree species in the uplands and by sycamore, tulip poplar, and red maple in the floodplains. Forest interior bird species occur in the lower part of the Watts Branch stream valley.

Watts Branch Rapid Stream Assessment

Figure 14



Water Quality

Current Conditions

The Watts Branch mainstem, including areas identified in the *Countywide Stream Protection Strategy* as upper Watts Branch, middle Watts Branch, and lower Watts Branch, is categorized as being in fair condition based on six water quality monitoring stations (MCDEP 1997) (see Figure 10).

In a study of Watts Branch using the rapid stream assessment technique (RSAT), Biohabitats, Inc. (1997) concluded that the overall RSAT scores for each of the catchments are in the fair to good range (see Figure 14). This was interpreted as evidence of slight to moderate levels of degradation. The sections of stream with the lowest ratings were in the most heavily developed portions of the watershed and included roadway crossings and reaches that were piped or severely eroded. Measurements of physical and chemical parameters were generally consistent with the Maryland Use I-P designation.

A study of the portion of the headwaters for Watts Branch upstream of Gude Drive was conducted as part of a large development project by Loiederman Associates (1996, 1997). The results of water quality sampling showed that all the parameters evaluated were within the normal ranges and that none exceeded the Use I-P limits. However, the benthic macroinvertebrate community present was categorized as "pollution tolerant," meaning that species sensitive to poor water quality were not present.

In 1997, a study for the city of Rockville was conducted (EA 1997b). A portion of this study included sampling fish and benthic macroinvertebrates at seven stations in Watts Branch and its tributaries in the headwater portions of Watts Branch (Scott Drive and upstream). The results of these sampling efforts were compared to reference streams identified by the Montgomery County Department of Environmental Protection. As a result, the seven stations were categorized as having marginal to suboptimal habitat conditions, with a poor macroinvertebrate community and a fair fish community (EA 1997b).

Historical Data

The water quality of Watts Branch was characterized as good in 1972 and excellent in 1973 (Gannett Fleming Corddry and Carpenter 1975) based on Montgomery County Department of Environmental Protection data on eight parameters, including temperature, dissolved oxygen, pH, BOD, nitrate, phosphate, turbidity, and total and fecal coliform. The lowest quality stream reach was the section upstream of Scott Drive in Rockville.

In 1990-1991, Maryland DNR (Gougeon 1990, Rivers 1991) and M-NCPPC (Van Ness, 1991) evaluated two stations in Watts Branch (Gregerscroft Road and Wootton Mill Park), and two stations in the lower portion of Piney Branch. Maryland DNR concluded that these streams display high water quality and diverse benthic and fish assemblages, with Piney Branch having higher water quality, and habitat suitable for trout in several of the areas evaluated. Field notes documented the limitations of physical habitat. Sixteen species of fish were recorded for the Gregerscroft station on Watts Branch, 7 species for the Wootton Mill Park station on Watts Branch, 17 species for Piney Branch upstream of Glen Road, and 9 species in Piney Branch at Glen Mill and Boswell Lane.

In 1996, Watts Branch was monitored as part of the County's baseline monitoring program with a watershed report due to the Maryland Department of the Environment in March, 1998.

Based on macroinvertebrate samples collected by Maryland DNR in 1991 at two stations in Piney Branch (Glen Road and Cutters Lane), a Hilsenhoff Biotic Index (HBI) score representative of very good conditions was indicated. Similar results were reported for samples collected at two stations on the mainstem of Watts Branch (at Gregerscroft Road and Aintree Court), although each of these stations also had early spring samples categorized as fair (Rivers, 1996).

In 1994, Watts Branch was categorized as having unimpaired stream habitat but a severely impacted biological community due to suburban runoff (Garrison 1994).

The Audubon Naturalist Society (ANS) conducted stream sampling at a station in Watts Branch (behind 10311 Glen Road) and at a station in Piney Branch (behind 11001 Glen Road) in 1994 and 1995. The results for stream habitat quality for Watts Branch and Piney Branch were representative of habitat in the marginal to suboptimal range. Similar results were reported in 1996 and 1997 in sampling efforts conducted by the ANS at three stations, one in the lower Watts Branch, and two in the upper Watts Branch at Woodley Gardens and at College Gardens. Stream habitat scores were categorized as marginal, suboptimal, and suboptimal, respectively.

Montgomery County Department of Environmental Protection monitoring (1996) of Watts Branch stream conditions in 1996 indicates that fish and benthic communities are in fair condition in upper Watts Branch and improved in the downstream areas.

Interpretation of Trends

While a considerable amount of historical information is available on the Watts Branch watershed (see Appendix,

Watts Branch Sensitive Areas

Figure 15

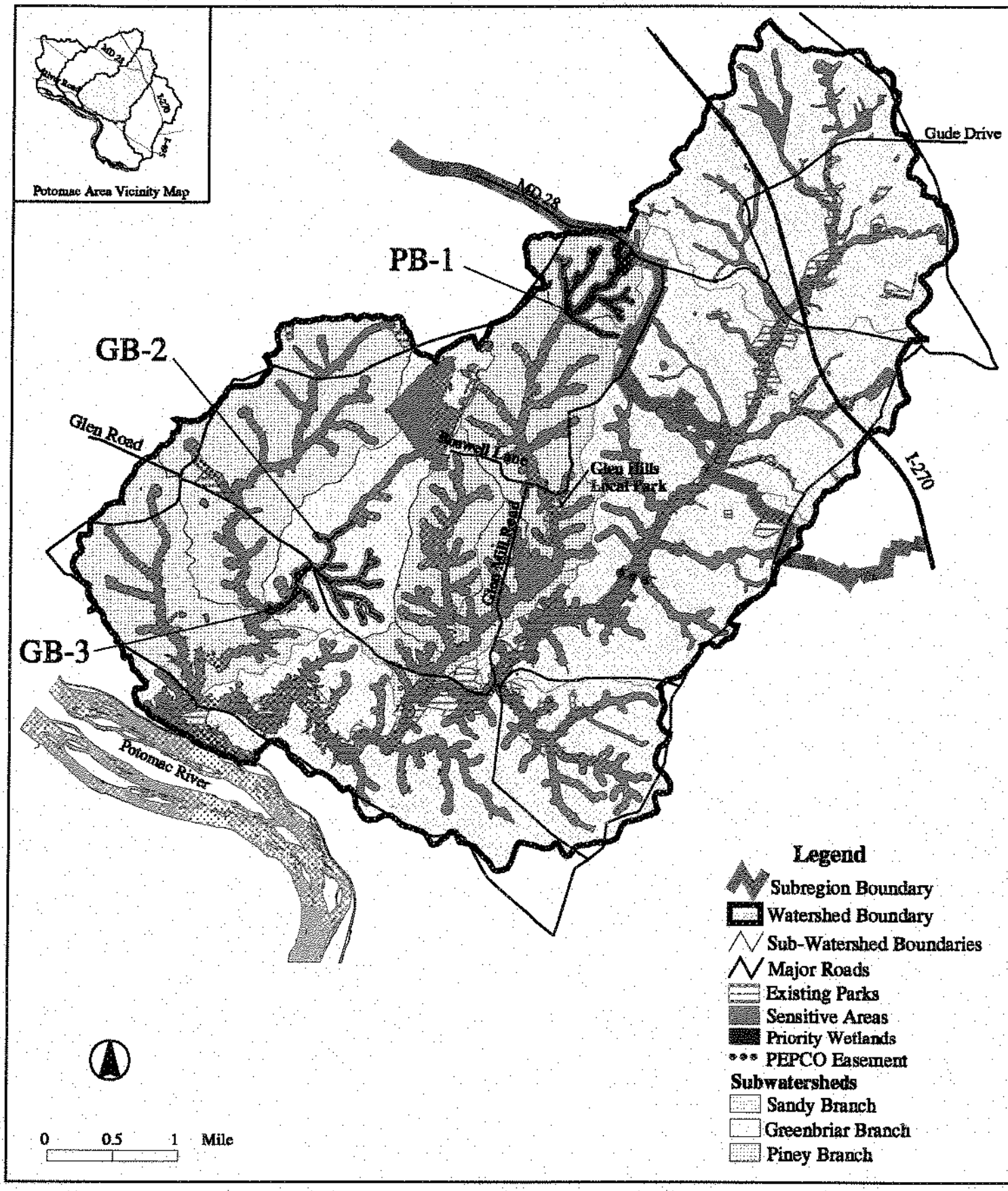


Table A-7), the existing data are neither uniform across the watershed nor sufficiently robust to support a generalized characterization of trends in stream condition. The subwatersheds of Watts Branch exhibit non-uniform characteristics that preclude extrapolating conclusions from one area to another. Monitoring at first was strictly chemical and physical. Later, biological and habitat monitoring were developed to give a more accurate picture of the conditions in the stream for various plants and animals. These two sampling methods are complementary, but are not necessarily comparable.

In the early 1970s, stream water quality in the Watts Branch watershed was regarded as good to excellent, except in portions of Rockville, where presumably urbanization was having a negative effect (Gannett Fleming Corddry and Carpenter 1975). Water quality appeared to decrease from excellent in 1976 to permissible until 1979. A water quality data gap for 1979 to 1990 precludes a discussion of that period, but the trend of degrading water quality beginning in 1977 likely continued in the portions of Watts Branch and its tributaries associated with urban development until the mid-1980s, when additional regulations to protect surface waters were adopted (e.g., Maryland stormwater regulations). It is unlikely that such a trend of degradation occurred in the portions of the Watts Branch watershed not subjected to land development activities (e.g., lower Watts Branch and its tributaries and Piney Branch). Water quality data for the period 1991 through 1997 are within normal ranges, and it is likely that the existing trend for base flow conditions would best be characterized as stable or improving.

Benthic macroinvertebrate data covers the period 1991 through 1997, but no trend is evident. Generally the macroinvertebrate data indicate stream conditions in the fair range, which agrees with the CSPS conclusions.

Fisheries data for the upper reach of Watts Branch include a survey from 1972, and a series of surveys from 1990 through 1997. It appears that this resource is on a degrading trend, with taxa richness decreasing from 22 species in the 1972-1974 period to less than a dozen species in 1997. However, many variables, such as sampling efforts, are not accounted for and therefore a degrading trend may not be representative of the entire Watts Branch watershed.

Stream habitat data for the period 1993 through 1997 are insufficient to support a characterization of any trend of the stream habitat. These survey methods have only recently been developed and were not conducted historically.

Sensitive Areas and Wetlands

Sensitive areas are defined by the 1992 State Planning Act as streams and their buffers; 100-year floodplains; steep slopes; and habitats of rare, threatened, and endangered species. For purposes of this report, wetlands also are considered sensitive areas and are included in the relevant maps and tables. These features generally are contained within the stream valleys and in the Watts Branch mainstem are largely within parkland (see Figure 15).

Wetlands in this watershed are closely associated with the stream system, with vernal pools, seeps, and other areas of standing water present. Deciduous forested wetlands are the predominant wetland type. Approximately 1,075 acres of wetland areas are present in this watershed within the Potomac Subregion (EA 1997a).

Wetlands along the Watts Branch mostly are located within parklands bordering the mainstem. The habitat value of these wetlands varies depending on the width of the park and proximity to development. Wetlands adjacent to large tracts of forest or meadow have the highest habitat value. Along the upper Watts Branch mainstem are extensive forested wetlands and vernal pools, seasonally flooded shallow depressions that provide important habitat for breeding amphibians. Along lower Watts Branch are several large wet meadows with cattails, cinnamon fern (*Osmunda cinnamomea*), swamp milkweed (*Asclepias incarnata*), dogwood, buttonbush (*Cephalanthus occidentalis*), asters, and goldenrod. The wetlands in this watershed are often fragmented by the placement of utility rights-of-ways (e.g., gas and electric, sanitary sewer, etc.).

Twenty locations in the Watts Branch watershed were evaluated for wetland function. Six were located on the mainstem of Watts Branch, six in the Piney Branch subwatershed, one in the Sandy Branch subwatershed, one in the Stoney Creek subwatershed, three in the Greenbriar Branch subwatershed and three in the Kilgour Branch subwatershed. The functional scores for wetlands in the Watts Branch watershed range from low to high, depending on the condition of the wetlands in each assessment group. KB1, for example, in the upper reaches of Kilgour Branch, has low scores due to a piped stream channel and development that filled in the historic wetland. Three of these wetland assessment groups were identified as priority wetlands based on their high composite scores for aquatic and wildlife habitat. These three Wetland assessment groups are described below (see Figure 15):

- PB1 — two headwater tributaries of Piney Branch.
- GB2 — Greenbriar Branch south of Palatine Road to Glen Road.
- GB3 — West of Glen Road to confluence with Sandy Branch

The wetland areas documented by the M-NCPPC in this watershed include forested, emergent, and open water

wetlands. In-stream habitat associated with the forested, scrub-shrub, and emergent wetlands is moderately to severely stressed throughout the Watts Branch watershed. Streambank erosion, downcutting within the channel, tree loss, extensive deposition, and heavy sediment loads were observed during field investigations.

Kilgour Branch Stream Valley Park in the Kilgour Branch subwatershed contains extensive areas of mature forest with many large specimen trees. Forested wetlands, seasonally or permanently flooded, are the predominant wetland type. These wetlands are dominated by red maple, sycamore, box elder, and spicebush. A large beaver dam has flooded an area of willows and red maples, creating a large swamp and an excellent habitat for wildlife.

Floodplain associated with the mainstem of Watts Branch and its Kilgour Branch tributary is generally contained within park boundaries. However, most of the 100-year floodplain associated with the remaining tributaries to Watts Branch extends onto privately owned land. This includes Piney Branch, Sandy Branch, and Greenbriar Branch.

Several bridges located along the mainstem may be impacted by the 100-year floodplain (Greenhorn and O'Mara, Inc. 1978). These locations are depicted on the Water Resources Map of Montgomery County (M-NCPPC 1988). Flooding problems in the vicinity of the Watts Branch crossings with Wootton Parkway and Glen Road were noted in an earlier report focusing on storm runoff problems (Gannett Fleming Corddry and Carpenter 1975).

Piney Branch

Watershed Character

The Piney Branch is a developing subwatershed within the Watts Branch basin (see Figure 15). The stream conditions in Piney Branch have been determined to be of high quality. In recognition of these facts, Piney Branch has been designated a special protection area (SPA).

Special protection areas have been designated where high quality or sensitive water resources and related environmental features are threatened by proposed land uses and a higher level of protection is needed (M-NCPPC 1997). Development in these areas is subject to a requirement to prepare a water quality plan, and to provide expanded wetland buffer widths, and expanded and accelerated forest conservation requirements. Current estimates of existing imperviousness in Piney Branch range from 6 to 10 percent according to the CSPS (see Appendix Table A-4).

Forests in the Piney Branch basin are generally associated with the stream channel and adjacent slopes and include various oak species, sycamores and tulip poplars (M-NCPPC 1997).

Water Quality

Current Conditions

The Piney Branch subwatershed of Watts Branch is categorized by the CSPS as having water quality in the fair-to-good range (MCDEP 1997). Piney Branch has lower quality stream conditions in the area around Glen Hill Local Park. The entire watershed, with the exception of the uppermost reaches, was stressed by the droughts occurring in previous years as well as by sediment deposition from developments approved before special protection requirements were in force. With strict adherence to special protection area requirements for new development, the Piney Branch should recover (Van Ness, 1997).

In a study of Piney Branch using the rapid stream assessment technique (RSAT), Biohabitats (1997) concluded that the overall RSAT scores for each of the catchments is in the fair-to-good range (see Figure 14).

Historical Data

Since 1994, the Montgomery County Department of Environmental Protection has monitored the Piney Branch Special Protection Area for fish, benthic macroinvertebrates, stream habitat, and selected physical parameters. Appendix Table A-7 contains a table summarizing historical and current water quality monitoring information.

Sensitive Areas and Wetlands

Sensitive areas are defined by the 1992 State Planning Act as streams and their buffers; 100-year floodplains; steep slopes; and habitats of rare, threatened, and endangered species. For the purposes of this report, wetlands also are considered sensitive areas and are included in the relevant maps and tables. These features generally are contained within the stream valleys and inPiney Branch are largely outside parkland (see Figure 15). Floodplain associated with Piney Branch extends onto privately owned land. Protection of these areas relies on the implementation of the *Environmental Guidelines* and County floodplain regulations.

The headwaters of Piney Branch originate from several springs and seeps south of Darnestown Road, eventually flowing into two small streams, which form the right and left forks of Piney Branch. This headwater area (undeveloped at the time of this survey) has high functional value for terrestrial and aquatic life provided by the streams, wetlands and forest and by the lack of development. This

area, wetland assessment group PB1, was identified as a priority wetland. Farther downstream, chains of vernal pools and small braided streams near or within the sewer line right-of-way create excellent habitat near the Piney Branch mainstem. Within the more developed areas of the Piney Branch watershed are large wet meadows and forested wetlands, dominated by cattails, rushes and sedges, or red maple and ash. The wetland areas in this watershed are often interrupted by road crossings, utility rights-of-ways, and sewer line easements. With the exception of Glen Hills Park, floodplain associated with Piney Branch extends onto privately owned land.

Greenbriar Branch

Watershed Character

Most of the upper Greenbriar Branch subwatershed is underlaid by serpentine outcrops. The soil in these areas is thin and severely limits development. In addition, the plant and animal communities that are present include species considered to be rare in the region and in some cases rare in the world.

The natural vegetation of the Greenbriar Branch watershed, as with the Watts Branch watershed as a whole, is dominated by deciduous species, specifically red and white oaks. Other tree species within this watershed include sycamore, tulip poplar, and red maple. In the upper portion of the Greenbriar Branch watershed, the influence of the serpentine soils can be observed where post oak, blackjack oak, and pitch pine become significant components of the forest.

Water Quality

Current Conditions

The Greenbriar Branch tributary to Watts Branch is identified in the *Countywide Stream Protection Strategy* as a stream in good habitat and overall fair biological condition (MCDEP 1997).

In a study of Greenbriar Branch using the rapid stream assessment technique (RSAT), Biohabitats, Inc. (1997) concluded that the majority of the RSAT scores for each of the catchments is in the good range with one catchment, the Greenbriar East tributary, receiving a fair score (see Figure 14).

Historical Data

Historical water quality information specific to the Greenbriar Branch is not available.

Sensitive Areas and Wetlands

Sensitive areas are defined by the 1992 State Planning Act as streams and their buffers; 100-year floodplains; steep slopes; and habitats of rare, threatened, and endangered species. For the purposes of this report, wetlands also are considered sensitive areas and are included in the relevant maps and tables. These features generally are contained within the stream valleys and in Greenbriar Branch are largely outside parkland (see Figure 15). Floodplain associated with Greenbriar Branch extends onto privately owned land. Protection of these areas relies on the implementation of the *Environmental Guidelines* and County floodplain regulations.

The wetland areas within this watershed are generally closely associated with the stream valley; however, wetland areas also occur outside the floodplain. Several seeps and ponds are present in the vicinity of the stream valley. The floodplain canopy and adjacent slopes are dominated by deciduous species. The understory plants vary by location.

The headwaters of Greenbriar Branch once originated on the land now occupied by the Rockville Crushed Stone Quarry. Rainwater that accumulates in the quarry now is pumped through a regulated discharge to the Sandy Branch. Greenbriar Branch now begins southwest of the power line crossing, where several seeps form long, braided channels. These wetlands are dominated by red maple, red and white oak, and hickory. The lower watershed contains two abandoned farm ponds with standing water containing emergent plants. Both ponds are surrounded by forested wetlands. The wetland assessment areas GB2 and GB3 were designated as priority wetlands based on their high scores for aquatic and wildlife habitat (see Figure 15).

The wetland areas in this watershed are moderately fragmented by road crossings, utility line rights-of-way, and sewer line easements.

Sandy Branch

Watershed Character

Sandy Branch is part of the larger Watts Branch watershed (see Figure 15). This drainage basin has been relatively undeveloped, with imperviousness ranging between six to nine percent (see Appendix Table A-4). Recent and current development is creating significant changes, especially in the headwaters areas. Serpentine soils cover much of the area, bringing with them the limitations to development and changes to native vegetation discussed in earlier sections. The forests of the Sandy Branch watershed, as with the Watts Branch watershed as a whole, are dominated by deciduous species, specifically red and white oaks. Other tree species within this watershed include sycamore, tulip poplar, and red maple.

As noted in the discussion of the Greenbriar Branch watershed the Rockville Crushed Stone Quarry discharges to the uppermost part of the Sandy Branch subwatershed. The flow in the Sandy Branch tributary nearest the quarry is significantly influenced by the flow from the pumps rather than normal rainfall events and groundwater.

Water Quality

Current Conditions

The Sandy Branch tributary to Watts Branch is separated in the *Countywide Stream Protection Strategy* report into upper Sandy Branch and lower Sandy Branch. Upper Sandy Branch is categorized as having fair stream conditions; lower Sandy Branch conditions are rated good. (MCDEP 1997).

Historical Data

The water quality of Sandy Branch, a tributary to Watts Branch, was characterized as good in 1972 and excellent in 1973 (Gannett Fleming Corddry and Carpenter 1975) based on Montgomery County Department of Environmental Protection data on eight parameters, including temperature, dissolved oxygen, pH, BOD, nitrate, phosphate, turbidity, and total and fecal coliform.

In a study of Sandy Branch using the rapid stream assessment technique (RSAT), Biohabitats, Inc. (1997) concluded that the overall RSAT scores for each of the catchments is in the fair-to-good range (see Figure 14).

Sensitive Areas and Wetlands

Sensitive areas are defined by the 1992 State Planning Act as streams and their buffers; 100-year floodplains; steep slopes; and habitats of rare, threatened, and endangered species. For the purposes of this report, wetlands also are considered sensitive areas and are included in the relevant maps and tables. These features generally are contained within the stream valleys and, in Sandy Branch, are largely outside parkland (see Figure15). Floodplain associated with Sandy Branch generally extends onto privately owned land. Protection of these areas relies on the implementation of the *Environmental Guidelines* and County floodplain regulations.

The wetlands in the Sandy Branch watershed are forested and include communities of red maple, sycamore, tulip poplar, and beech. Several small wetlands within the floodplain are covered with invasive vegetation such as Asiatic tearthumb (*Polygonum perfoliatum*) which has little value for wildlife. The headwaters of Sandy Branch have been piped and the stream flows through concrete and grass swales. Wetlands associated with these headwaters have been filled for residential development, prior to State wetland regulations.

Cabin John Creek

Watershed Character

Located in the eastern portion of the Potomac Subregion, Cabin John is the most developed watershed in the Potomac Subregion (see Figure 16). The headwaters of this stream lie outside the Potomac Subregion, as do a number of tributary streams. Approximately two-thirds of the watershed is more than 20 percent impervious, and approximately one-half the watershed is more than 25 percent impervious (MCDEP 1997). Within the Potomac Subregion, levels of imperviousness in the Cabin John Creek range from 11 to 27 percent (see Appendix Table A-4).

Stream conditions in the Cabin John Creek watershed are typical of an urbanized area, including reduced baseflow, increased channel flow velocities during stormwater runoff events, degraded water quality, and degraded instream habitat.

Forests in the Cabin John Creek watershed include a combination of deciduous and coniferous/evergreen species. Tree species present in this watershed include white oak, tulip poplar, American beech, red maple, white ash, box elder, white pine (*Pinus strobus*), pawpaw (*Asimina triloba*), mountain laurel, dogwood, viburnum, and spicebush (Shosteck 1978). Approximately 1,800 acres of forest areas are present in this watershed within the Potomac Subregion (EA 1997a).

Woodland stands of any significant size present in the Cabin John Creek watershed occur primarily in the stream valley and on the adjacent slopes within parkland. Woodland plants and wildlife, including forest interior dwelling species that require large stands of woodland, are found in these forests (see Figure 5).

Water Quality

Current Conditions

Cabin John Creek was monitored in 1996 as part of the County's baseline monitoring program. The upper Cabin John Creek was described as in fair stream condition; Buck Branch, Ken Branch, and Congressional Branch in good condition; and the Deborah Drive tributary, lower Old Farm tributary, and Capital Beltway (I-495) Branch were found to be in poor condition. The middle mainstem and lower mainstem are in fair condition.

The *Countywide Stream Protection Strategy* (DEP, 1997) categorizes Cabin John Creek as having degraded

habitat areas as a result of uncontrolled stormwater from North Bethesda and Rockville. Overall, the stream resource condition in Cabin John Creek is categorized as fair to poor.

In addition, the CSPS (1997) indicated several tributaries of Cabin John Creek that appear to be capable of supporting an improving fish community, indicating that the trend of resource degradation in Cabin John Creek may be reversing.

Historical Data

A study published in 1982 by CH2M-Hill concluded that Cabin John Creek consistently exceeded Maryland water quality limits for fecal coliform over the period 1971 through 1979, but seldom exceeded State standards for dissolved oxygen, temperature, or turbidity based on the monitoring studies conducted by the Montgomery County Department of Environmental Protection.

From 1977 to 1985, Cabin John Creek has experienced a trend of degradation in stream quality on the basis of total suspended sediment loads. While this trend was reported, it was not statistically significant (Maryland Department of the Environment 1988).

A study of the aquatic resources in seven streams comprising the headwater sections of Cabin John Creek north of Montrose Road (Galli and Trieu 1994) was conducted using the Rapid Stream Assessment Technique (RSAT). This study concluded that the streams were best characterized as being in fair condition, due primarily to uncontrolled stormwater input from approximately 60 to 70 percent of the developed watershed. This resulted in widened and degraded stream channels, reduced baseflow, and lower water quality during periods of high flow. A number of restoration concepts and site-specific actions were identified and recommended, including the removal of six barriers to fish movement.

Stream survey work conducted by the Audubon Naturalist Society at one station in Cabin John Creek (mainstem of creek off Democracy Boulevard behind Locust Grove Nature Center) from 1994 to 1995 indicated stream habitat quality was in the marginal to suboptimal range.

A study of the entire Cabin John Creek watershed using RSAT was conducted between 1992 and 1995 (Galli et al. 1996), with the conclusion that stream conditions were generally fair. Eight tributary and nine mainstem stations had RSAT scores ranging from 14 to 31, with all but two of these scores in the fair range; and of the two scores outside this range, one was in the good range and one was in the poor range. The study reported that the stream habitat was limited, with approximately six percent of the length of Cabin John Creek categorized as severely eroded. Thirteen exposed sewer lines were identified; and widespread channel degradation (downcutting), excess sediment deposition, and bar formation were observed in other reaches. Barriers to fish movement were identified. Water quality was generally fair to somewhat poor. The study indicated that Cabin John Creek and its tributaries generally had good riparian habitat conditions, and good benthic invertebrate community condition. The study also recommended a number of restoration concepts and specific stream reaches suitable for restoration.

Interpretation of Trends

The circumstances outlined above, combined with the fact that much of this watershed was developed without the benefit of modern environmental regulations (MCDEP 1997), provide a ready explanation for the evident historic pattern of degraded aquatic resources. The water quality of the basin for the entire period of record (since 1971) has been plagued with fecal coliform levels in excess of Maryland water quality standards. In addition, total suspended sediments (TSS) have been an issue from the mid-1970s to the mid-1980s. Baseflow water quality is reported to have improved since the mid-1980s, but the State monitoring reports (MDE 1991, 1994) reported high bacteria, high nutrients, and high TSS, which are characteristic of a degraded resource.

Stream habitat is not a useful measure for comparing existing stream conditions to historic stream conditions because this measurement was not a standard part of stream assessments prior to about 1988.

The information on the macroinvertebrate community in the Cabin John basin is insufficient for evaluating trends in the resource.

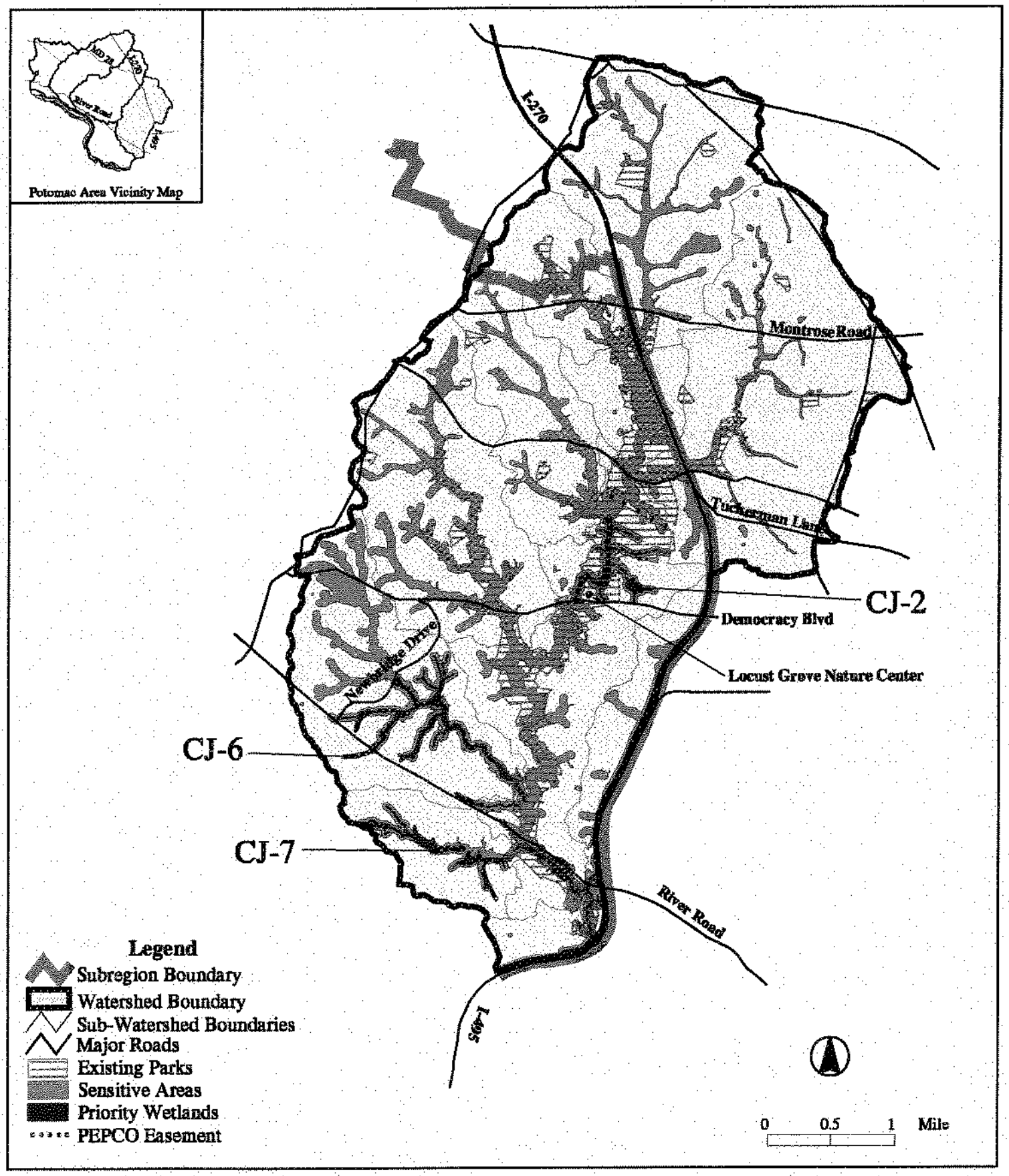
Data from fish sampling efforts conducted as early as 1899 are available for this basin and indicate that from the late 1800s to the mid-1940s, a diverse assemblage of fish was present in this watershed. Thirty years later Dietemann (1975) reported a reduced diversity overall, with only pollution-tolerant species remaining in the more developed portions of the watershed. More recently, Galli and Trieu (1993) documented 52 barriers to fish movement in this basin. Clearly, between the mid-1940s and mid-1970s, the trend was one of degradation.

Sensitive Areas and Wetlands

Sensitive areas are defined by the 1992 State Planning Act as streams and their buffers; 100-year floodplains; steep slopes; and habitats of rare, threatened, and endangered species. For the purposes of this report, wetlands also are considered sensitive areas and are included in the relevant maps and tables. These features generally are contained within the stream valleys and in the Cabin John Creek mainstem are largely within parkland (see Figure 16).

Cabin John Creek Sensitive Areas

Figure 16



The wetlands of the Cabin John Creek watershed are generally associated with the channel. The canopy of the floodplain and the adjacent slopes is dominated by deciduous species.

Although Cabin John Creek has been severely degraded by excessive stormwater flows, channel erosion, and sedimentation, the surrounding parklands serve as habitat "islands" within this densely developed area of the Potomac Subregion. Forested wetlands and vernal pools are the most common wetland types. The wetlands are associated with a canopy of red maple, tulip poplar, red oak, and beech.

The understory plant species vary by location. Approximately 760 acres of wetland areas are present in this watershed within the Potomac Subregion (EA 1997a).

Wetland types that are mapped by National Wetland Inventory are dominated by forested, emergent, and open water wetland areas in this watershed. Generally, the wetland assessment groups of the Cabin John Creek watershed occurring in parkland represented the best wetland conditions in the watershed. Throughout the watershed, the forested canopy cover was interrupted by an overwide stream channel, a high-density network of perpendicular and parallel roads and utility rights-of-way, and residential/commercial development.

Eight locations in the Cabin John Creek watershed were evaluated for wetland function, one of which was located in Buck Branch. The wetlands of the Cabin John Creek watershed generally received moderate-to-high scores for the five wetland functions evaluated. Three of these wetland assessment groups were identified as priority wetlands based on the high composite scores for aquatic and wildlife habitat. The locations of these wetland assessment groups are listed below (see Figure 16):

- CJ2— mainstem and tributaries of Cabin John Creek from PEPCO right-of-way downstream to Democracy Boulevard.
- CJ6 — tributary southeast of Newbridge Drive to confluence with mainstem.
- CJ7 — mainstem and tributaries of Cabin John Creek along south side of River Road to I-495.

Floodplain associated with the mainstem of Cabin John Creek and its Buck Branch tributary is generally contained within park boundaries. Floodplain associated with the remaining tributaries to Cabin John Creek in the planning area extend onto private land. This includes Snakeden Branch, Ken Branch, Bogley Branch, and other small tributaries.

A report on flooding in the Cabin John Creek watershed concluded that currently it is not a serious problem (CH2M-Hill 1982). The report did inventory a number of locations where flooding of property, including houses, was likely to occur. The most noteworthy location within the Potomac Subregion was the mainstem of Cabin John Creek and the Bull Run tributary in the vicinity of Bradley Boulevard.

Rock Run

Watershed Character

Rock Run is the only watershed entirely within the Potomac Subregion with the exception of the very small tributaries that flow directly into the Potomac River (see Figure 17). This watershed is noted for historic gold mining and a steep stream gradient. Evidence of the gold mining is still seen in areas of Rock Run where the stream channel was blasted with dynamite. Toxic chemicals also may have been used to separate the gold from the parent ore material.

Rock Run is a watershed with steep forested slopes adjacent to forested floodplains. Approximately 800 acres of forest areas are present in the watershed (EA 1997a). Tree species include tulip poplar, box elder, sycamore, white oak, southern red oak, dogwood, and musclewood. Virginia pine, chestnut oak, black cherry, American beech, red maple, and basswood (*Tilia americana*) are also present (Shosteck 1978). Some of the larger forest blocks may be capable of supporting forest interior dwelling bird species.

Although the village of Potomac is located in the headwaters, the Rock Run watershed has, to date, escaped many of the effects of urbanization common in watersheds developed years earlier (e.g., Watts Branch and Cabin John Creek). Much of the watershed is dominated by large lot subdivisions, with higher density residential development interspersed, especially near the Village of Potomac and in the southern portion of the watershed. Imperviousness in the Rock Run watershed is estimated by the CSPS to be in the range of 25 to 30 percent.

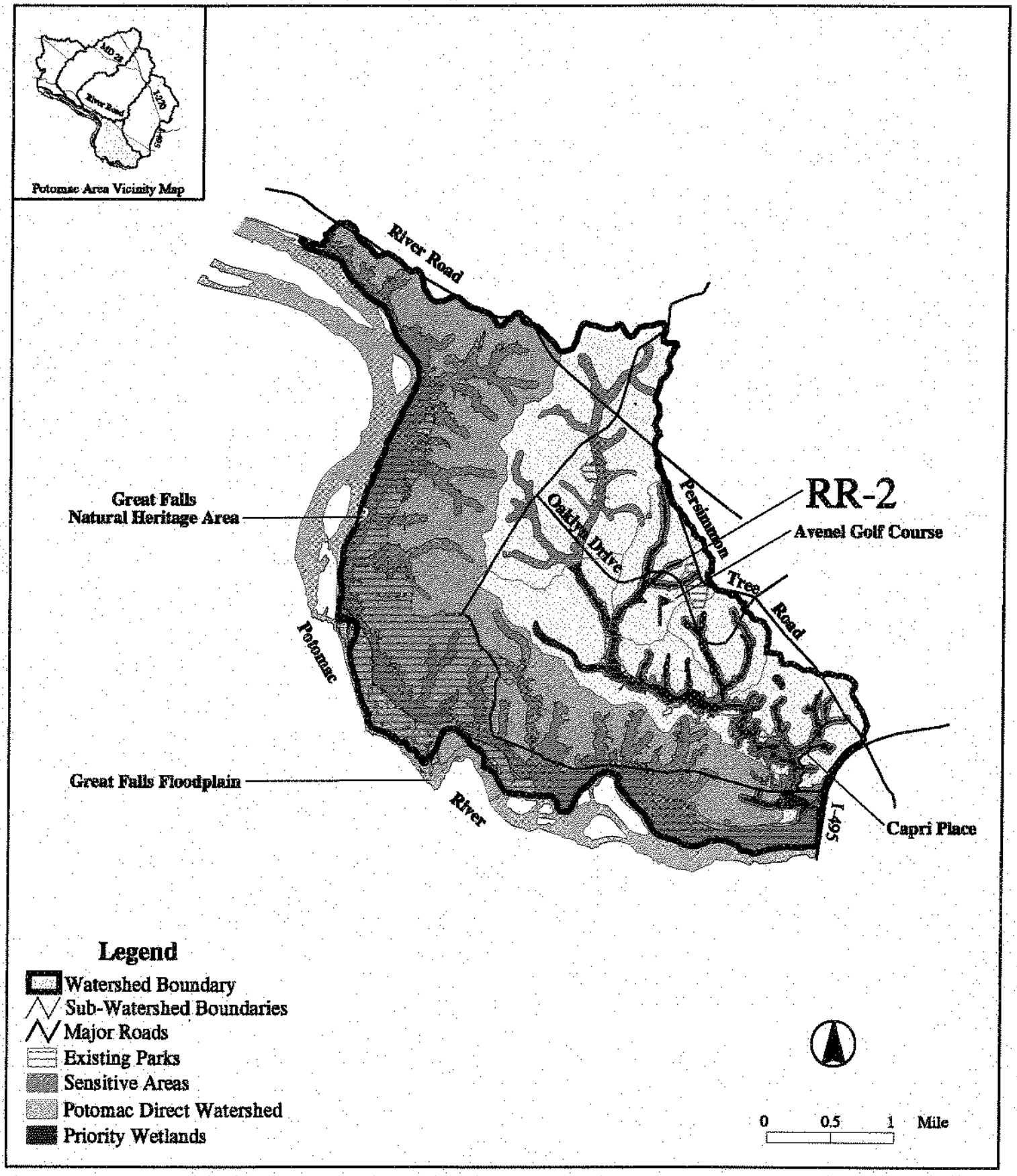
Water Quality

Current Conditions

The *Countywide Stream Protection Strategy* (MCDEP, 1997) indicates that the stream habitats in Rock Run are generally good, due in part to the forested cover remaining in and around the stream valleys of Rock Run. The macroinvertebrate community was identified as an indicator of some degree of impairment, based on low population levels. The CSPS concludes that the water quality is impaired because it does not attain the type of biological communities that are indicated by its stream habitat. Upper Rock Run has a poor overall resource condition; lower Rock Run has a fair condition overall.

Rock Run and Potomac Direct Sensitive Areas

Figure 17



Historical Data

A study conducted by CH2M-Hill (1982), concluded that Rock Run exceeded Maryland water quality criteria for fecal coliform in 1972, 1976, 1977, and 1979, while other monitored parameters (dissolved oxygen, temperature, and turbidity) were within State standards, based on the monitoring studies conducted by the Montgomery County Department of Environmental Protection. (See Appendix Table A-9 for a summary of historical and current water quality monitoring.)

A habitat assessment performed by the Audubon Naturalist Society at two stations in Rock Run in 1995 in the vicinity of MacArthur Boulevard characterized the stream habitat as suboptimal to optimal.

A study of a proposed sewer crossing in the vicinity of Capri Place found a diverse and healthy benthic community on a tributary of Rock Run.

Interpretation of Trends

Little information is available to evaluate trends in stream conditions. Water quality monitoring results indicate that the fecal coliform standard frequently (i.e., 50 percent of the time) is exceeded (CH2M-Hill 1982). The water quality of Rock Run continues to be a problem, as evidenced by the presence of good stream habitat but an impaired invertebrate community (MCDEP 1997).

Habitat conditions are characterized as good to excellent for the 1995 to 1997 time frame, with no habitat data from earlier periods. As presented above, the invertebrate community has been characterized as impaired on the basis of low invertebrate population levels.

On the basis of fish collections from 1915 and 1974, fish diversity remained excellent when fish diversity in other streams (e.g., Cabin John) was reduced. However, based on information presented in the 1996 CSPS, fish diversity has been reduced by approximately 50 percent from 1974 to the present, based on a record of 21 species in 1915; 21 species in 1974; and 11 species in 1996. Such a decrease could result from degraded water quality, or from unrelated sampling issues (reduced sampling effort, etc.).

Sensitive Areas and Wetlands

Sensitive areas are defined by the 1992 State Planning Act as streams and their buffers; 100-year floodplains; steep slopes; and habitats of rare, threatened; and endangered species. For the purposes of this report, wetlands also are considered sensitive areas and are included in the relevant maps and tables. These features generally are contained within the stream valleys and, in Rock Run, are largely outside parkland (see Figure 17).

Approximately 425 acres of wetland areas are present in this watershed within the Potomac Subregion (EA 1997a). Forested wetlands, vernal pools, and small ponds are the most common wetland types in this watershed. The wetlands occur near the mainstem and tributaries of Rock Run or at the base of steep slopes, where groundwater discharges form springs or seeps. Wetland vegetation includes tulip poplar, sycamore, box elder, white oak, dogwood, and multiflora rose.

The Rock Run mainstem has a relatively steep gradient when compared to other surface waters in the Potomac Subregion. Although this small watershed was developed prior to stormwater management regulations, it includes parkland and golf course areas that reduce the adverse impact of excessive stormwater flows on wetlands in the watershed.

Two groups of wetlands in the Rock Run watershed were evaluated for wetland function. Based on the scores for these wetland assessment groups, it can be concluded that the wetlands have functional scores in the moderate to good range. Based on the composite habitat score (sum of aquatic and wildlife habitat scores), RR2 was identified as a priority wetland area. This wetland assessment group includes the mainstem and tributaries of Rock Run from the confluence of Rock Run with the Potomac River upstream to the vicinity of Oaklyn Drive.

Floodplain associated with Rock Run is not all contained within parkland. About half the known floodplain areas extend onto privately owned land. Several areas were identified as having a potential for flooding (CH2M-Hill 1982). Most of theses areas are located in the steep headwaters of Rock Run between River Road and Falls Road.